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THE
NATURAL HISTORY
OF THE
HUMAN TEETH.

PART I.

[Price One Guinea, bound with the Second Part.]

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THE

NATURAL HISTORY

OF THE

HUMAN TEETH:

EXPLAINING THEIR

STRUCTURE, USE, FORMATION,

GROWTH, AND DISEASES.

ILLUSTRATED WITH COPPER-PLATES.

By JOHN HUNTER,

Surgeon Extraordinary to the KING, and Fellow of the ROYAL SOCIETY.

THE SECOND EDITION.

LONDON,
Printed for J. JOHNSON, N°. 72, St. Paul's Church-Yard.
MDCCLXXVIII.

1778

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MOST of the Obſervations contained in the following Treatiſe were made by the Author before the Year 1755; and the Subſtance of them conſtantly demonſtrated after that Period, in Dr. Hunter's Courſe of Anatomical Lectures. The Figures were drawn by Mr. Rymſdyk, under the Author's Direction, and engraved by Meſſ. Strange, Grignion, Ryland, and others.

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THE

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ERRATA.

Page 28. l. 18. for *Theroide* read *Thyroide*.
38. l. 2. for *mal* read *Animal*.
117. l. 14. dele *to*.

OF THE

UPPER-JAW.

BEFORE we enter into a deſcription of the Teeth themſelves, it will be neceſſary to give an account of the Upper and Lower Jaw-bones, in which they are inſerted; inſiſting minutely on thoſe parts which are connected with the Teeth, or ſerve for their motion and action, and paſſing over the others ſlightly.

The Upper-Jaw is compoſed of two bones, which generally remain diſtinct through life. They are very irregular at their poſterior and upper parts, ſending upwards and backwards a great many proceſſes, that are connected with the bones of the Face and Skull *. The lower and anterior parts of the Upper-Jaw are more uniform, making a kind of a circular ſweep from ſide to ſide, the convexity of which is turned forwards; the lower part terminates in a thick edge, full

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* Vide Plate III. Fig. 1ſt and 2d. A A.

of ſockets for the Teeth. This edge is called in each bone the Alveolar Proceſs *. Behind the Alveolar Proceſſes there are two horizontal lamellæ, which uniting together, form part of the roof of the Mouth, which is the partition between the Mouth and the Noſe †.

This plate, or partition, is ſituated about half an inch higher than the lower edge of the Alveolar Proceſs; and this gives the roof of the Mouth a conſiderable hollowneſs.

The uſe of the Upper-Jaw is to form part of the Parietes of the Mouth, Noſe, and Orbits; to give a baſis, or ſupply the Alveolar Proceſs, for the ſuperior row of Teeth, and to counteract the Lower Jaw; but it has no motion itſelf upon the bones of the Head and Face.

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* Vide Plate I. Fig. 1. *a*, *b*, *c*, *d*.

† Vide Plate I. Fig. 1. *e*, *e*.

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OF THE

LOWER-JAW.

As the Lower-Jaw is extremely moveable, and its motion is indiſpenſably neceſſary in all the various operations of the Teeth, it requires to be more particularly deſcribed. It is much more ſimple in its form than the Upper, having fewer proceſſes, and theſe not ſo irregular. Its anterior circular part is placed directly under that of the Upper-Jaw; but its other parts extend farther backwards *.

This Jaw is at firſt compoſed of two diſtinct bones †; but theſe, ſoon after birth, unite into one, at the middle of the chin. This union is called the Symphyſis of the Jaw. Upon the upper edge of the body of the bone is placed the Alveolar Proceſs, a good deal ſimilar to that of the Upper-Jaw. The Alveolar Proceſs extends all round the upper part of the bone, from the Coronoide Proceſs of one ſide, to that of the other ‡. In both Jaws they are every where relatively propor-

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* Vide Plate III. Fig. 1 and 2.

† Vide Plate VIII. Fig. 1, 4, and 6.

‡ Vide Plate I. Fig. 2.

tional to the Teeth; being thicker behind, where the Teeth are larger, and more irregular, upon account of the more numerous fangs inſerted into them. The Teeth that are ſituated backwards, in the Upper-Jaw, have more fangs than thoſe that correſpond with them in the lower, and the ſockets are accordingly more irregular. The Alveolar Proceſs of the Upper-Jaw, is a ſection of a larger circle than that of the lower, eſpecially when the Teeth are in the ſockets. This ariſes chiefly from the anterior Teeth in the Upper-Jaw being broader and flatter than thoſe in the Lower *. The poſterior part of the bone on each ſide riſes almoſt perpendicularly, and terminates above in two proceſſes †; the anterior of which is the higheſt, is thin and pointed, and is called the Coronoide Proceſs ‡. The anterior edge of this proceſs forms a ridge, which goes obliquely downward and forward on the Jaw, upon the outſide of the poſterior ſockets §. To this proceſs the Temporal Muſcle is attached; and as it riſes above the center of motion, that Muſcle acts with nearly equal advantage in all the different ſituations of the Jaw.

The Poſterior Proceſs, which is made for a moveable articulation with the head, runs upward, and a

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* Vide Plates I. and III.

† Vide Plate III. Fig. 2. *e*; and Plate IV. Fig. 2.

‡ Vide Plate IV. *i i*.

§ Vide Plate IV. Fig. 2. B.

little backward; is narrower, thicker, and ſhorter, than the anterior; and terminates in an oblong rounded head, or Condyle *, whoſe longeſt axis is nearly tranſverſe. The Condyle is bended a little forward; is rounded, or convex, from the fore to the back part; and likewiſe a little rounded from one end to the other, or from right to left. Its external end is turned a little forward, and its internal a little backward; ſo that the axis of the two Condyles are neither in the ſame ſtraight line, nor parallel to each other; but the axis of each Condyle, if continued backwards, would meet, and form an angle of about one hundred and forty-ſix degrees; and lines drawn from the Symphyſis of the Chin, to the middle of the Condyle, would interſect their longeſt axis, at nearly right angles †. There are, however, ſome exceptions; for in a Lower-Jaw, of which I have a drawing, the angle formed by the ſuppoſed continuation of the two axes, inſtead of being an angle of one hundred and forty-ſix degrees, is of one hundred and ten only. The Lower-Jaw ſerves for a baſe to ſupport the Teeth in the Alveolar Proceſs, during their action on thoſe of the Upper-Jaw in maſtication; and to give origin to ſome muſcles that belong to other parts.

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* Vide Plate IV. Fig. II. E. al. f

† Vide Plate I. Fig. 2. or Plate IV. Fig. 2.

OF

OF THE

ALVEOLAR PROCESSES.

THE Alveolar Proceſſes are compoſed of two thin bony plates, one external *, and the other internal †. Theſe two plates are at a greater diſtance from each other at their poſterior ends, than at the anterior, or middle part of the Jaw. They are united together by thin bony partitions going a-croſs, which divide the proceſſes at the anterior part, into juſt as many diſtinct ſockets as there are Teeth ‡; but at the poſterior part, where the Teeth have more than one root or fang, there are diſtinct cells, or ſockets, for every root §. Theſe tranſverſe partitions are more protuberant than the Alveolar Plates; and thus add laterally to the depth of the Cells, particularly at the anterior part of the Jaw. At each partition, the external plate of the Alveolar Proceſs is depreſſed, and forming furrows, or a fluting ‖ rounds the cells, or cavi-

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* Vide Plate I. Fig. 1. *a*, *a*, *a*, *a*, *a*.

† Vide Plate I. Fig. 1. *b*, *b*, *b*.

‡ Vide Plate I. Fig. 1. *c*, *c*, and Fig. 2, *a*.

§ Vide Plate I. Fig. 1, *d*, *d*. and Fig. 2. *b*, *c*.

‖ Vide Plate III. Fig. 2. F F F F.

cavities, for the roots of the Teeth. This is obſervable in the whole length of the Alveolar Proceſs of the Upper-Jaw; and in the fore-part particularly of the Lower-Jaw. The Alveolar Proceſſes of each Jaw, form about one half of a circular, or rather of an elliptical * figure; and at the fore-part in the Lower-Jaw they are perpendicular, but project inwards at the poſterior part, and deſcribe a ſmaller circle than the body of the bone upon which they ſtand †; as we ſhall obſerve more particularly hereafter, when we come to treat of the Jaws of Old People.

The Alveolar Proceſſes of both Jaws ſhould rather be conſidered as belonging to the Teeth, than as parts of the Jaws; for they begin to be formed with the Teeth, keep pace with them in their growth, and decay, and intirely diſappear, when the Teeth fall; ſo that, if we had no Teeth, it is likely we ſhould not only have no ſockets, but not even theſe proceſſes, in which the ſockets are formed; and the Jaws can perform their motions, and give origin to muſcles, without either the Teeth, or Alveolar Proceſſes. In ſhort, there is ſuch a mutual dependence of the Teeth, and Alveolar Proceſſes on each other, that the deſtruction of the one ſeems to be always attended with that of the other.

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* Vide Plate I. Fig. 1. and 2.

† Vide Plate I. Fig. 2.

In the head of a young ſubject which I examined, I found that the two firſt Inciſor Teeth in the Upper-Jaw had not cut the Gum; nor had they any root or fang, excepting ſo much as was neceſſary to faſten them to the Gum, on their upper ſurface; and on examining the Jaw, I found there was no Alveolar Proceſs, nor ſockets, in that part. What had been the cauſe of this, I will not pretend to ſay: whether it was owing to the Teeth forming not in the Jaw, but in the Gum; or to the waſting of the fangs. The appearance of the Tooth favoured the firſt ſuppoſition; for it was not like thoſe, whoſe fangs are decayed in young ſubjects, in order to the ſhedding of the Teeth; and as it did not cut the Gum, it is reaſonable to think it never had any fang. That end from which the fang ſhould have grown, was formed into two round and ſmooth points, having each a ſmall hole leading into the body of the Tooth, which was pretty well formed.

OF THE

ARTICULATION of the LOWER-JAW.

JUST under the beginning of the Zygomatic Proceſs of each Temporal Bone, before the external Meatus Auditorius, an oblong cavity may be obſerved; in direction, length, and breadth, in ſome meaſure correſponding with the Condyle of the Lower-Jaw *. Before, and adjoining to this cavity, there is an oblong eminence, placed in the ſame direction, convex upon the top, in the direction of its ſhorter axis, which runs from behind forwards; and a little concave in the direction of its longer axis, which runs from within outwards. It is a little broader at its outer extremity; as the outer correſponding end of the Condyle deſcribes a larger circle in its motion than the inner †. The ſurface of the cavity, and eminence, is covered with one continued ſmooth cartilaginous cruſt, which is ſomewhat ligamentous, for by putrefaction it peels off, like a membrane, with the common Perioſteum. Both the cavity and eminence ſerve for the mo-

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* Vide Plate II. L. and Plate IV. E E.

† Vide Plate II. K. and Plate XIV. F F.

tion of the Condyle of the Lower-Jaw. The ſurface of the cavity is directed downward; that of the eminence downward and backward, in ſuch a manner that a tranſverſe ſection of both would repreſent the Italick letter *S* *. Though the eminence may, on a firſt view of it, appear to project conſiderably below the cavity, yet a line drawn from the bottom of the cavity, to the moſt depending part of the eminence, is almoſt horizontal, and therefore nearly parallel with the line made by the grinding ſurfaces of the Teeth in the Upper-Jaw: and when we conſider the Articulation farther, we ſhall find that theſe two lines are ſo nearly parallel, that the Condyle moves almoſt directly forwards, in paſſing from the cavity to the eminence; and the paralleliſm of the motion is alſo preſerved by the ſhape of an intermediate cartilage.

In this joint there is a moveable cartilage, which, though common to both Condyle and cavity, ought to be conſidered rather as an appendage of the former than of the latter, being more cloſely connected with it; ſo as to accompany it in its motion along the common ſurface of both the cavity and eminence. This cartilage is nearly of the ſame dimenſions with the Condyle, which it covers; is hollowed on its inferior ſurface, to receive the Condyle: on its upper ſurface it is more unequal, being moulded to the cavity and eminence of the articulating ſurface of the Temporal Bone, though it is conſiderably leſs, and is therefore capable of being moved with the Condyle, from one part of that ſurface to another *. Its texture is ligamento-cartilagineous. This moveable cartilage is connected with both the Condyle of the Jaw, and the articulating ſurface of the Temporal Bone, by diſtinct ligaments, ariſing from its edges all round. That by which it is attached to the Temporal Bone, is the moſt free and looſe; though both ligaments will allow an eaſy motion, or ſliding of the cartilage on the reſpective ſurfaces of the Condyle, and Temporal Bone. Theſe attachments of the cartilage are ſtrengthened, and the whole articulation ſecured, by an external ligament, which is common to both, and which is fixed to the Temporal Bone, and to the neck of the Condyle. On the inner ſurface of the ligament, which attaches the cartilage to the Temporal Bone, and backwards, in the cavity, is placed what is commonly called the Gland of the Joint; at leaſt, the ligament is there much more vaſcular than at any other part.

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* Vide Plate II. I, K.

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* Vide Plate II. L.

OF THE

MOTION in the JOINT of the LOWER-JAW.

THE Lower-Jaw, from the manner of its articulation, is ſuſceptible of a great many motions. The whole Jaw may be brought horizontally forwards, by the Condyles ſliding from the cavity towards the eminences on each ſide. This motion is performed chiefly when the Teeth of the Lower-Jaw are brought directly under thoſe of the Upper, in order to bite, or hold any thing very faſt between them.

Or, the Condyles only may be brought forwards, while the reſt of the Jaw is tilted backwards, as in the caſe when the Mouth is open; for on that occaſion the angle of the Jaw is tilted backwards, and the chin moves downwards, and a little backwards alſo. In this laſt motion, the Condyle turns its face a little forwards; and the center of motion lies a little below the Condyle, in the line between it and the angle of the Jaw. By ſuch an advancement of the Condyles forwards, together with the rotation mentioned, the aperture of the Mouth may be conſiderably enlarged; a circumſtance neceſſary on many obvious occaſions.

The Condyles may alſo ſlide alternately backwards and forwards, from the cavity to the eminence, and *vice verſa*; ſo that while one Condyle advances, the other moves backwards, turning the body of the Jaw from ſide to ſide, and thus grinding, between the Teeth, the morſel ſeparated from the larger maſs by the motion firſt deſcribed. In this caſe, the center of motion lies exactly in the middle between the two Condyles. And it is to be obſerved, that in theſe ſlidings of the Condyles forwards and backwards, the moveable cartilages do not accompany the Condyles in the whole extent of their motion; but only ſo far as to adapt their ſurfaces to the different inequalities of the Temporal Bone: for as theſe cartilages are hollow on their lower ſurfaces where they receive the Condyle, and on their oppoſite upper ſurfaces are convex where they lie in the cavity; but forwards, at the root of the eminence, that upper ſurface is a little hollowed; if they accompanied the Condyles through the whole extent of their motion, the eminences would be applied to the eminences, the cavities would not be filled up, and the whole articulation would be rendered very inſecure.

This account of the motion of the Lower-Jaw, and its cartilages, clearly demonſtrates the principal uſe of theſe cartilages; namely, the ſecurity of the articulation; the ſurfaces of the cartilage accommodating themſelves to the different inequalities, in the various and

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free motions of this joint. This cartilage is alſo very ſerviceable for preventing the parts from being hurt by the friction; a circumſtance neceſſary to be guarded againſt, where there is ſo much motion. Accordingly, I find this cartilage in the different tribes of Carnivorous Animals, where there is no eminence and cavity, nor other apparatus for grinding; and where the motion is of the true ginglimus kind only.

In the Lower-Jaw, as in all the joints of the body, when the motion is carried to its greateſt extent, in any direction, the muſcles and ligaments are ſtrained, and the perſon made uneaſy. The ſtate, therefore, into which every joint moſt naturally falls, eſpecially when we are aſleep, is nearly in the middle, between the extremes of motion; by which means all the muſcles and ligaments are equally relaxed. Thence it is, that commonly, and naturally, the Teeth of the two Jaws are not in contact; nor are the Condyles of the Lower-Jaw ſo far back in the Temporal Cavities as they can go.

OF THE

MUSCLES of the LOWER-JAW.

HAVING deſcribed the figure, Articulation, Motion, and uſe of the Lower-Jaw, it will be neceſſary, in the next place, to give ſome account of the Muſcles that are the cauſes of its motion.

There are five pair of Muſcles, each of them capable of producing various motions, according to the ſituation of the Lower-Jaw, whether they act ſingly, or in conjunction with others; and two or more of them may be ſo ſituated, as to be capable of moving the Jaw in the ſame direction; and every motion is produced by the action of more than one Muſcle at a time. Thus, if the Jaw is depreſſed, and brought to one ſide, either the Maſſeter, Temporal, or Pterigoidæus internus of the oppoſite ſide will not only raiſe the Jaw, but bring it to its middle ſtate. It will be neceſſary in the deſcription of each Muſcle, to give its uſe in the different ſituations of the Jaw; by which means, after they are all deſcribed, their compound actions will be better underſtood. I ſhall firſt deſcribe thoſe which raiſe the Jaw; then thoſe which give it the lateral motion; and laſtly, thoſe which depreſs it; proceeding in each claſs as they riſe in diſſection.

The moſt ſuperficial is the Maſſeter: it is ſituated upon the poſterior and lower part of the Face, between the cheek-bone, and angle of the Lower-Jaw, directly before the lower part of the Ear. It is a thick, ſhort, complex Muſcle, and a little flattened; it appears to have two diſtinct origins, an anterior outer, and a poſterior inner; but that is owing only to its outer edge at its origin being ſlit, or double; and the fibres of theſe two edges having a different courſe, decuſſating each other a little. The anterior, and outer portion of the Muſcle begin to riſe from a ſmall part of the lower edge of the Malar Proceſs of the Maxillary Bone, adjoining to the Os Malæ; and continues its origin all along the lower horizontal edge of this laſt bone, to the angle where its Zygomatic Proceſs turns up, to join that of the Temporal Bone. The external layer of fibres in this portion are tendinous at their beginnings, while the internal are fleſhy.

The poſterior and inner portion of this Muſcle begins to riſe partly tendinous, and partly fleſhy, from the ſame lower edge of the Os Malæ; not where the origin of the other portion terminates, but a little farther forwards; and this origin is continued along the lower edge of the Zygomatic Proceſs of the Temporal Bone, as far backwards as the eminence belonging to the articulation of the Lower-Jaw.

From this extent of its origin, the Muſcle paſſes downwards to its inſertion into the Lower-Jaw. The anterior external portion is broader at its inſertion than at its origin; for it occupies a triangular ſpace of the Lower-Jaw above the angle, and on the outſide, of about an inch in ſize, to about an inch and a half from the angle towards the Chin. In conſequence of this extent of inſertion, the fibres of this portion divaricate very conſiderably. They are moſtly fleſhy at their inſertion, a few only being tendinous, particularly thoſe that are inſerted backwards. The poſterior and inner portion of the Maſſeter is narrower at its inſertion than at its origin; its poſterior fibres running forwards, as well as downwards, while its anterior run almoſt directly downwards. It occupies in its inſertion the remaining part of the ſcabrous ſurface, above the angle of the Lower-Jaw, which lies between the anterior portion and the two upper proceſſes, viz. the Condyle and Coronoide. As the anterior fibres of this portion riſe on the inſide of the poſterior fibres of the other portion; and as its poſterior fibres run forwards as well as downwards, and its anterior run almoſt directly downwards, while the fibres of the other portion radiate both forwards and backwards; theſe two portions in ſome meaſure decuſſate, or croſs one another.

other. The anterior fibres, which run fartheſt and loweſt down, are tendinous at their inſertion, while the poſterior and ſhorteſt are fleſhy.

The uſe of the whole Muſcle is to raiſe the Lower-Jaw; and when it is brought forwards, the poſterior and inner portion will aſſiſt in bringing it a little back; ſo that this Muſcle becomes a rotator, if the Jaw happens to be turned to the oppoſite ſide.

We may obſerve, that this Muſcle is intermixed with a number of tendinous portions, both at its origin and its inſertion; which give riſe to a greater number of fleſhy fibres, and thereby add to the ſtrength of the Muſcle.

TEMPORALIS.

IT is ſituated on the ſide of the Head, above, and ſomewhat before the Ear. It is a pretty broad, flat, and radiated Muſcle; broad and thin at its origin; narrow and thick at its inſertion; and is covered with a pretty ſtrong Faſcia, above the Jugum.

This Faſcia is fixed to the bones round the whole circumference of the origin of the Muſcle. Above, it is fixed to a ſmooth white line, that is obſervable upon the Skull, extending from a little ridge on the lateral part of the Os Frontis, continued acroſs the Parietal Bone, and making a turn towards the Mamillary Proceſs. It is fixed below, to the ridge where the Zygomatic Proceſs begins, juſt above the Meatus Auditorius; then to the upper edge of the Zygomatic Proceſs itſelf, and anteriorly to the Os Malæ. This adheſion, anteriorly, above, and poſteriorly, gives, as it were, the circumference of the origin of the Temporal Muſcle.

This Muſcle ariſes from all the bones of the ſide of the Head, that are within the line, for inſertion of the tendinous Faſcia, viz. from the lower and lateral part of the Parietal Bone, from all the ſquammous portion of

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the Temporal Bone, from the lower and lateral part of the Os Frontis, from all the Temporal Proceſs of the Os Sphenoides, and often from a proceſs at the lower part of this ſurface, (which portion, however, is often common to this Muſcle, and the Pterygoidæus externus) and from the poſterior ſurface of the Os Malæ. Outwardly, it riſes from the inner ſurface of the Jugum, and from the whole inner ſurface of the Faſcia above deſcribed. At this origin, from the Jugum it is not to be diſtinguiſhed from the Maſſeter, being there, in fact, one and the ſame Muſcle; and indeed the Maſſeter is no more than a continuation of the ſame origin, under the edge of the Jugum; and might properly enough be reckoned the ſame, both as to its origin and inſertion, and in ſome meaſure in its uſe alſo.

The origin is principally fleſhy; and the Muſcle paſſes from it, in general, downwards, and a little forwards, converging, and forming a thin middle tendon. After which the Muſcle runs downwards, on the inſide of the Jugum, and is inſerted into the Coronoid Proceſs of the Lower-Jaw, on both ſides tendinous and fleſhy, but principally tendinous. It reaches farther down upon the inſide of the Coronoid Proceſs, than upon the outer ſide, where the inſertion is continued as low as the body of the bone.

The poſterior and inferior edge of this Muſcle paſſes over the root of the Zygomatic Proceſs of the Temporal Bone, as over a pulley, which confines the action of the Muſcle to that of raiſing the Lower-Jaw, more than if its fibres had paſſed in a direct courſe from their origin to their inſertion.

The uſe of the Temporal Muſcle, in general, is to raiſe the Lower-Jaw; and as it paſſes a little forwards to its inſertion, it muſt bring the Condyle at the ſame time backwards, and ſo counteract the Pterygoidæus externus of the oppoſite ſide; and if both Muſcles act, they counteract both the Pterygoidæi, by bringing back the whole of the Jaw.

PTERYGOIDÆUS INTERNUS.

IT is ſituated upon the inſide of the Lower-Jaw, oppoſite to the Maſſeter, which is upon the outſide. It is a ſtrong ſhort Muſcle, a little flattened, eſpecially at its inſertion. It ariſes tendinous and fleſhy from the whole internal ſurface of the external Ala of the Sphenoid Bone; from the external ſurface of the internal Ala, near its bottom; from that proceſs of the Os Palati that makes part of the Foſſa Pterygoidæa; likewiſe from the anterior rounded ſurface of that proceſs, where it is connected to the Os Maxillare ſuperius. From thence the Muſcle paſſes downwards, a little outwards and backwards, and is inſerted tendinous and fleſhy into the inſide of the Lower-Jaw, from the angle, up almoſt to the groove for the admiſſion of the Maxillary Nerve, where the ſurface of the bone is remarkably ſcabrous.

The Uſe of this Muſcle is to raiſe the Lower-Jaw; and from its direction, one would ſuſpect that it would bring the Condyle a little forwards; but this motion is contrary to that of the Lower-Jaw, for it is naturally brought back when raiſed.

PTERY-

PTERYGOIDÆUS EXTERNUS,

IS ſituated immediately between the external ſurface of the external Ala of the Pterygoid Proceſs, and the Condyle of the Lower-Jaw; lying, as it were, horizontally along the baſis of the Skull. It is ſomewhat radiated in ſome bodies; broad at the origin, and ſmall at the inſertion; but the greater part of it forms a round ſtrong fleſhy belly; ſo that the part that makes it of the radiated kind is thin.

The thick and ordinary portion of it ariſes tendinous and fleſhy, from almoſt the whole external ſurface of the external Ala of the Pterygoid Proceſs of the Sphenoid Bone, excepting a little bit of the root at the poſterior edge; and towards the lower part, it ariſes a little from the inner ſurface of that Ala. The thin portion ariſes from a ridge of the Sphenoid, that is continued from the proceſs towards the Temple, juſt behind the Foramen Lacerum inferius, which terminates in a little protuberance. This origin is ſometimes wanting; and in that caſe, the Temporal Muſcle ariſes from that protuberance; and very often this origin is common to both. Theſe two origins of this Muſcle are ſometimes ſo much ſeparated, as to make it a Biceps.

From theſe origins the Muſcle paſſes outwards, and a little backwards, converging ; that is, the ſuperior fibres paſſing outwards and backwards, and a little downwards ; while the inferior, or larger portion of it, paſſes a little upward.

It is inſerted tendinous and fleſhy into a depreſſion on the anterior part of the Condyle and Neck of the Lower-Jaw, upon the inſide of that ridge, which is continued from the Coronoid Proceſs. Likewiſe a little portion into the anterior part of the moveable cartilage. A little portion is likewiſe inſerted into the anterior part of the moveable cartilage of the joint.

When this Muſcle acts ſingly it is a rotator ; for it brings the Condyle of the Jaw forwards, and likewiſe the moveable cartilage, which throws the Chin to the oppoſite ſide : but if it acts in conjunction with its fellow of the oppoſite ſide, inſtead of being turned to one ſide, the whole Jaw is brought forwards, and thus theſe counteract the Temporal, &c.

Theſe two Muſcles generally act alternately ; and when they do ſo, one acts at the time of depreſſion, the other at the time of elevation ; ſo that theſe Muſcles act, both when the Lower-Jaw is raiſed, and when it is depreſſed : yet they do not aſſiſt either in raiſing or depreſſing it.

DIGASTRICUS.

IT is ſituated immediately under, and a little upon the inſide of the Lower-Jaw, and outſide of the Fauces, extending from the Maſtoid Proceſs to the Chin, nearly along the angle made by the Neck and Chin, or Face *. The name of this Muſcle expreſſes its general ſhape, as it has two fleſhy bellies, and of courſe a middle tendon. Yet ſome of its anterior belly does not ariſe from the tendon of the poſterior, but from the Faſcia, which binds it to the Os Hyoides. Theſe two fleſhy bellies do not run in the ſame line, but form an angle, juſt where the tendon runs into the anterior belly; ſo that this tendon ſeems rather to belong to the poſterior, which is the thickeſt and longeſt.

This Muſcle ariſes from the Sulcus made by the inſide of the Maſtoid Proceſs, and a ridge upon the Temporal Bone, where it is united with the Os Occipitis. The extent of this origin is about an inch: it is fleſhy upon its outer part, viz. that from the Maſtoid Proceſs, and tendinous on the inſide from the ridge. From its

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* Vide Plate II. E F.

origin it paſſes forwards, downwards, and a little inwards, much in the direction of the poſterior edge of the Mammillary Proceſs; and forms a round tendon firſt in its center and upper ſurface. This tendon paſſes on in the ſame direction; and when got near the Os Hyoides, it commonly perforates the anterior end of the Stylo Hyoideus Muſcle; and from the lower edge of this tendon, ſome fibres ſeem to go off, which degenerate into a kind of Faſcia, that binds it to the Os Hyoides; and ſome of it goes acroſs the lower part of the Mylo-Hyoidæus, and joins its fellow on the oppoſite ſide; binding the Os Hyoides by a kind of belt. At this part the tendon becomes a little broader, makes a turn upwards, inwards, and forwards, and gives origin to the anterior belly, which paſſes on in the ſame direction, to the lower part of the Chin, where it is inſerted tendinous and fleſhy, into a ſlight depreſſion on the under, and a little on the poſterior part of the Lower-Jaw, almoſt contiguous to its fellow. Beſides the attachment of the middle tendon to the Os Hyoides, there is a ligamentous binding, which ſerves, in ſome meaſure, as a pulley. This is more marked in ſome ſubjects than in others; and this depends on the ſtrength of the tendinous expanſion, which binds the tendon of the Digaſtricus to the Os Hyoides.

When we ſay that theſe parts are attached to the

Os Hyoides, we do not mean that they can be traced quite into it, like ſome other tendons in the body; but the Os Hyoides ſeems to be the moſt fixt point of attachment. Very often we find two anterior bellies to each Muſcle; the uncommon one, which is the ſmalleſt, does not paſs to the Chin, but joins with a ſimilar portion of the other ſide, in a middle tendon, which is often fixed to the Os Hyoides. At other times, we find ſuch a portion on one ſide only; in which caſe it is commonly fixed to the middle tendon of the Mylo-Hyoidæus.

The uſe of theſe Muſcles with regard to the Lower-Jaw, is principally to depreſs it; but according as one acts a little more forcibly than the other, it thereby gives the Jaw a ſmall rotation; and becomes, in that reſpect, a kind of antagoniſt to the Pterygoidæus Externus. Beſides depreſſing the Lower-Jaw, when we examine the dead body, they would appear to raiſe the Larynx. But although they have this effect, a proper attention to what happens in the living body, will probably ſhew, that their principal action is to depreſs the Lower-Jaw, and that they are the Muſcles which are commonly employed for this purpoſe. Let a Finger be placed on the upper part of the Sterno-Maſtoidæus Muſcle, juſt behind the poſterior edge of the Maſtoid Proceſs, about its middle, touching that edge a little with the finger; then depreſs the Lower-

Jaw, and the poſterior head of the Digaſtric will be felt to ſwell very conſiderably, and ſo as to point out the direction of the Muſcle. In this there can be no deception; for there is no other Muſcle in this part that has the ſame direction; and thoſe who are of opinion that the Digaſtric does not depreſs the Lower-Jaw, will more readily allow this, when they are told, that we find the ſame head of the Muſcle act in deglutition; but not with a force equal to that which it exerts in depreſſing the Lower-Jaw. Further, if the Sterno-Hyoidei, Sterno-Thyroidei, and Coſto-Hyoidei, acting at the ſame time with the Mylo-Hyoidei, and Genio-Hyoidei, aſſiſted in depreſſing the Jaw, the Os Hyoides, and Thyroide Cartilage, would probably be depreſſed, as the bellies of the Sterno-Hyoidei, and of the other lower muſcles, are by much the longeſt; but on the contrary, we find that the Os Hyoides, with the Theroïde Cartilage, is a little raiſed in the depreſſion of the Jaw, which we may ſuppoſe to be done by the anterior belly of the Digaſtric: and ſecondly, if theſe Muſcles were to act to bring about this motion of the Jaw, theſe parts would be brought forwards, nearer to the ſtraight line between the Chin and Sternum, which is not the caſe in this action; whereas we find it to be the caſe in deglutition, in which theſe evidently act. By applying our Fingers upon the Genio-Hyoideus, and Mylo-Hyoideus, near the Os Hyoides, between the two anterior bellies of the Digaſtric, (not near the Chin, where the action of theſe two bellies may occaſion a miſtake), we find theſe Muſcles quite flaccid; which is not the caſe in deglutition, nor in ſpeaking, in which they certainly do act; nor do we find the Muſcles under the Os Hyoides at all affected, as they are in the motion of the Larynx.

It has been obſerved, that when we open the mouth, while we keep the Lower-Jaw fixed, the forepart of the Head or Face is neceſſarily raiſed. Authors have been at a good deal of pains to explain this. Some of them conſidered the Condyles of the Jaw, as the center of motion; but if this were the caſe, that part of the Head, where it articulates with the Spine, and of conſequence the whole body, muſt be depreſſed, in proportion as the Upper-Jaw is raiſed; which is not true in fact. Others have conſidered the Condyles of the Occiput as the center of motion; and they have conceived the Extenſor Muſcles of the Head to be the moving powers. The Muſcles which move the Head in this caſe, are pointed out by two circumſtances, which attend all muſcular motion; in the firſt place, all actions of our body have Muſcles immediately adapted to them; and ſecondly, when the mind wills any particular action, its power is applied by inſtinct to thoſe Muſcles only, which are naturally adapted to that motion; and further, the mind being accuſtomed to ſee the part move which is naturally the moſt moveable, attends to its motion in the volition, although

though it be in that inſtance fixed, and the other parts of the body move towards it ; and although the other parts of the body might be brought towards it by other Muſcles, and would be ſo, if the mind intended that they ſhould come towards it, yet theſe Muſcles are not brought into action. Thus the Flexors of the Arm commonly move the hand to the body ; but if the hand be fixed, the body is moved by the ſame Muſcles to the hand. In this caſe, however, the mind wills the motion of the hand towards the body, and brings the Flexors into action ; whereas if it wiſhed to bring the body towards the hand, the Muſcles of the forepart of the body would be put into action, and this would produce the ſame effect.

To apply this to the Lower-Jaw ; when we attempt to open the Mouth, while the Lower-Jaw is immoveable, we fix our attention upon the very ſame Muſcles (whatever they are) which we call into action, when we depreſs the Lower-Jaw ; and we find that we act with the very ſame Muſcles ; for our mind attends to the depreſſing of the Jaw, and not the raiſing of the face ; and under ſuch circumſtances the mouth is actually opened. We find then by theſe means the head is raiſed ; and the idea that we have of this motion, is the ſame that we have in the common depreſſion of the Jaw ; and we ſhould not know, except from circumſtances, that the Jaw was not really depreſſed ; and we find at this time too, that the Extenſors of the head are not in action. On the contrary, when the Jaw is fixed in the ſame ſituation, if we have a mind to raiſe the head, or Upper-Jaw, which of courſe muſt open the mouth, we fix our attention to the Muſcles that move the head backwards, without having the idea of opening our mouth; and at this time the Extenſors of the head act. This plainly ſhows, that the ſame Muſcles which depreſs the Jaw, when moveable, muſt raiſe the head, when the Jaw is kept fixed.

This is a proof too, that there are no other Muſcles employed in depreſſing the Lower-Jaw, than what will raiſe the head under the circumſtances mentioned. This will further appear from the ſtructure of the parts; wherein four things are to be conſidered, viz. the articulation of the Jaw; the articulation of the Head with the Neck; the origin, and the inſertion of Digaſtric Muſcle.

* Suppoſe A, the Upper-Jaw, to be fixed, and the Lower-Jaw B, to be moveable on the Condyle C: if the Digraſtic contracts, its origin E, and inſertion F will approach towards one another; in which caſe it is evident, that the Lower-Jaw will move downwards and backwards. But if the Lower-Jaw be fixed, as in the caſe ſuppoſed, and the Vertebræ G G G be alſo fixed,

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* Vide Plate II.

the Condyle will move upwards and forwards upon the eminence in the joint, the forepart of the head will be puſhed upwards and backwards by the Condyle, and the hind part of the head will be drawn down; ſo that the whole ſhall make a kind of circular motion upon the upper Vertebræ; and the Digaſtric Muſcle pulling the hind part of the head towards the Lower-Jaw, and at the ſame time puſhing up the Condyles againſt the fore-part of the head, acquires, by this mechaniſm, a very conſiderable additional power.

OF THE

STRUCTURE of a TOOTH.

And, Firſt, of the ENAMEL.

A Tooth is compoſed of two ſubſtances, viz. Enamel and Bone. The Enamel, called likewiſe the vitreous, or cortical part, is found only upon the body of the Tooth, and is there laid all around, on the outſide of the bony, or internal ſubſtance *. It is by far the hardeſt part of our body; inſomuch that the hardeſt and ſharpeſt ſaw will ſcarce make an impreſſion upon it, and we are obliged to uſe a file in dividing or cutting it. When it is broken it appears fibrous or ſtriated; and all the fibres or ſtriæ are directed from the circumference to the center of the Tooth †.

This, in ſome meaſure, both prevents it from breaking in maſtification, as the fibres are diſpoſed in arches, and keeps the Tooth from wearing down, as the ends of the fibres are always acting on the food.

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* Vide Plate XIV. Fig. 14, 15, and 17.

† Vide Plate XIV. Fig. 21, 22, and 23.

The Enamel is thickeſt on the grinding ſurface, and on the cutting edges, or points, of the Teeth; and becomes gradually thinner on the ſides, as it approaches the neck, where it terminates inſenſibly, though not equally low, on all ſides of the Teeth *. On the baſe or grinding ſurface it is of a pretty equal thickneſs, and therefore is of the ſame form with the bony ſubſtance which it covers †.

It would ſeem to be an earth united with a portion of animal ſubſtance, as it is not reducible to quick lime by fire, till it has firſt been diſſolved in an acid. When a Tooth is put into a weak acid, the Enamel, to appearance, is not hurt; but on touching it with the fingers, it crumbles down into a white pulp. The Enamel of Teeth, expoſed to any degree of heat, does not turn to lime: it contains animal mucilaginous matter; for when expoſed to the fire, it becomes very brittle, cracks, grows black, and ſeparates from the incloſed bony part of the Tooth. It is capable, however, of bearing a greater degree of heat than the bony part, without becoming brittle and black ‡. This ſubſtance has no marks of being vaſcu-

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* Vide Plate XIV. Fig. 21, 22, and 23.

† Vide Ditto.

‡ From this circumſtance we can ſhew the Enamel better by burning a Tooth, as the bony part becomes black ſooner than the Enamel. The method of burning, and ſhewing them after they are burnt, is as follows.——Let one half of a Tooth be filed away, from one end to the other, then burn it gently in the fire; after this is done, waſh the filed ſurface

lar, and of having a circulation of fluids: the moſt ſubtile injections we can make never reach it; it takes no tinge from feeding with madder, even in the youngeſt animals; and, as was obſerved above, when ſoaked in a gentle acid, there appears no *griſtly* or *fleſhy* part, with which the earthy part had been incorporated *.

We ſhall ſpeak of the uſe and formation of the Enamel hereafter, when they will be better underſtood.

ſurface with an acid, or ſcrape it with a knife. By this method you will clean the edge of the Enamel, which will remain white, and the bony part will be found black.

* In all theſe experiments I never could obſerve, that the Enamel was in the leaſt tinged, either in the growing or formed Tooth. This looks as if the Enamel were the earth more fully depurated, or ſtrained off from the common juices in ſuch a manner, as not to allow the groſs particles of madder to paſs. Here it may not be amiſs to remark, that the names given to animal ſubſtance, ſuch as Gluten, &c. are not in the leaſt expreſſive of the thing meant; for there is no ſuch thing as glue in an animal, till it has either undergone a putrefactive proceſs, or been changed by heat. And here too I would be underſtood, that I call earth no part of an animal; nor does it make up any part of an animal ſubſtance.

OF THE

BONY PART of a TOOTH.

THE other ſubſtance of which a Tooth is compoſed, is bony; but much harder than the moſt compact part of bones in general. This ſubſtance makes the interior part of the body, the neck, and the whole of the root of a Tooth. It is a mixture of two ſubſtances, viz. calcarious earth and an animal ſubſtance, which we might ſuppoſe to be organized and vaſcular. The earth is in very conſiderable quantity; it remains of the ſame ſhape after calcination, ſo that it is in ſome meaſure kept together by coheſion; and it is capable of being extracted by ſteeping in the muriatic, and ſome other acids. The animal ſubſtance, when deprived of the earthy part, by ſteeping in an acid, is more compact than the ſame ſubſtance in other bones, but ſtill is ſoft and flexible.

That part of a Tooth which is bony, is nearly of the ſame form as a complete Tooth; and thence, when the Enamel is removed, it has the ſame ſort of edge, point, or points, as when the Enamel remained. We cannot by injection prove that the bony part of a Tooth is vaſcular: but from ſome circumſtances it would appear that it is ſo; for the Fangs of Teeth are liable to ſwellings, ſeemingly of the ſpina ventoſa kind, like other bones; and they ſometimes anchyloſe with the ſocket by bony and inflexible continuity, as all other contiguous bones are apt to do. But there may be a deception here, for the ſwelling may be an original formation, and the anchyloſis may be from the pulp that the Tooth is formed upon being united with the ſocket. The following conſiderations would ſeem to ſhew that the Teeth are not vaſcular: firſt, I never ſaw them injected in any preparation, nor could I ever ſucceed in any attempt to inject them, either in young or old ſubjects; and therefore believe that there muſt have been ſome fallacy in the caſes where they have been ſaid to be injected. Secondly, we are not able to trace any veſſels going from the pulp into the ſubſtance of the new-formed Tooth; and whatever part of a Tooth is formed, it is always completely formed, which is not the caſe with other bones. But what is a more convincing proof, is reaſoning from the analogy between them and other bones, when the animal has been fed with madder. Take a young animal, viz. a pig, and feed it with madder, for three or four weeks; then kill the animal, and upon examination you will find the following appearance: firſt, if this animal had ſome parts of its Teeth formed before the feeding with madder, thoſe parts will be known by their remaining of this natural colour; but ani

but ſuch parts of the Teeth as were formed while the mal was taking the madder, will be found to be of a red colour. This ſhews, that it is only thoſe parts that were forming while the animal was taking the madder that are dyed; for what were already formed will not be found in the leaſt tinged. This is different in all other bones; for we know that any part of a bone which is already formed, is capable of being dyed with madder, though not ſo faſt as the part that is forming; therefore as we know that all other bones when formed are vaſcular, and are thence ſuſceptible of the dye, we may readily ſuppoſe that the Teeth are not vaſcular, becauſe they are not ſuſceptible of it after being once formed. But we ſhall carry this ſtill farther; if you feed a pig with madder for ſome time, and then leave it off for a conſiderable time before you kill the animal, you will find the above appearances ſtill ſubſiſting, with this addition, that all the parts of the Teeth which were formed after leaving off feeding with the madder will be white. Here then in ſome Teeth we ſhall have white, then red, and then white again; and ſo we ſhall have the red and the white colour alternately through the whole Tooth.

This experiment ſhews, that the Tooth once tinged, does not loſe its colour; now as all other bones that have been once tinged loſe their colour in time, when the animal leaves off feeding with madder (though very ſlowly), and as that dye muſt be taken into the conſtitution by the abſorbents, it would ſeem that the Teeth are without abſorbents, as well as other veſſels.

This ſhews that the growth of the Teeth is very different from that of other bones. Bones begin at a point, and ſhoot out at their ſurface; and the part that ſeems already formed, is not in reality ſo, for it is forming every day by having new matter thrown into it, till the whole ſubſtance is complete; and even then it is conſtantly changing its matter.

Another circumſtance in which Teeth ſeem different from bone, and a ſtrong circumſtance in ſupport of their having no circulation in them, is that they never change by age, and ſeem never to undergo any alteration, when completely formed, but by abraſion; they do not grow ſofter, like the other bones, as we find in ſome caſes, where the whole earthy matter of the bones has been taken into the conſtitution.

From theſe experiments it would appear, that the Teeth are to be conſidered as extraneous bodies, with reſpect to a circulation through their ſubſtance; but they have moſt certainly a living principle, by which means they make part of the body, and are capable of uniting with any part of a living body; as will be explained hereafter: and it is to be obſerved, that affections of the whole body have leſs influence upon the Teeth than any other part of the body. Thus in children affected with the rickets, the Teeth grow equally well as in health, though all the other bones are much affected; and hence their Teeth being of a larger ſize in proportion to the other parts, their mouths are protuberant.

OF THE CAVITY of the TEETH.

EVERY Tooth has an internal Cavity, which extends nearly the whole length of its bony part[*]. It opens, or begins at the point of the fang, where it is ſmall; but in its paſſage becomes larger, and ends in the body of the Tooth[†]. This end is exactly of the ſhape of the body of the Tooth to which it belongs. In general it may be ſaid, that the whole of the Cavity is nearly of the ſhape of the Tooth itſelf, larger in the body of the Tooth, and thence gradually ſmaller to the extremity of the fang; ſimple, where the Tooth has but one root[‡]; and in the ſame manner compounded, when the Tooth has two or more fangs[§].

This Cavity is not cellular, but ſmooth in its ſurface: it contains no marrow, but appears to be filled with blood-veſſels *, and, I ſuppoſe, nerves, united by a pulpy or cellular ſubſtance. The veſſels are branches of the ſuperior and inferior Maxillaries; and the nerves muſt come from the ſecond and third branches of the fifth pair.

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[*] Vide Plate XIV. Fig. 1, 2, 3, &c.

[†] Vide Plate XIV. Fig. 1, 2. 3. &c.

[‡] Vide Plate XIV. Fig. 3, 4, 5, and 6.

[§] Vide Plate XIV. Fig. 1, 2.

By injections we can trace the blood-veſſels diſtinctly through the whole Cavity of the Tooth; but I could never trace the Nerves diſtinctly even to the beginning of the Cavity.

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* Vide Plate XII. Fig. 7, 8.

OF THE

PERIOSTEUM of the TEETH.

THE Teeth, as we obſerved, are covered by an Enamel only at their bodies ; but at their fangs they have a Perioſteum, which, though very thin, is vaſcular, and appears to be common to the Tooth which it incloſes, and the ſocket, which it lines as an inveſting internal membrane, It covers the Tooth a little beyond the bony ſocket, and is there attached to the Gum.

OF THE

SITUATION of the TEETH.

THE general ſhape and ſituation of the Teeth are obvious. The oppoſition of thoſe of the two Jaws, and the circle which each row deſcribes, need not be particularly explained, as they may be very well ſeen in the living body, and may be ſuppoſed to be already underſtood, from what was ſaid of the Alveolar Proceſſes.

We may juſt obſerve, with regard to the ſituation of the two rows, that when they are in the moſt natural ſtate of contact, the Teeth of the Upper-Jaw project a little beyond the lower Teeth, even at the ſides of the Jaws; but ſtill more remarkably at the fore part, where in moſt people the upper Teeth lie before thoſe of the Lower-Jaw *: and at the lateral part of each row, the line, or ſurface of contact, is hollow from behind forwards, in the Lower-Jaw; and in the ſame proportion it is convex in the Upper-Jaw †.

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* Vide Plate III. Fig. 1, 2.

† Vide Plate III. Fig. 1, 2.

The edge of each row is ſingle at the fore part of the Jaws; but as the Teeth grow thicker backwards, it there ſplits into an internal and external edge. The canine Tooth, which we ſhall call *Cuſpidatus*, is the point from which the two edges go off; ſo that the firſt grinder, or what we ſhall call the firſt *Bicuſpis*, is the firſt Tooth that has a double edge *.

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* Vide Plate IV. Fig. 1, 2.

OF THE

NUMBER of TEETH.

THEIR Number in the whole, at full maturity, is from twenty-eight to thirty-two: I once ſaw twenty-ſeven only, never more than thirty-two. Fourteen of them are placed in each Jaw, when the whole number is no more than twenty-eight; and ſixteen, when there are thirty-two. If the whole be twenty-nine or thirty-one in number, the Upper-Jaw ſometimes, and ſometimes the Lower, has one more than the other; and when the Number is thirty, I find them ſometimes divided equally between the two Jaws; and in other ſubjects ſixteen of them are in one Jaw, and fourteen in the other. In ſpeaking of the Number of Teeth, I am ſuppoſing that none of them have been pulled out, or otherwiſe loſt; but that there are from eight to twelve of thoſe large poſterior Teeth, which I call Grinders, and that they are ſo cloſe planted as to make a continuity in the circle: and in this caſe, when the number is leſs than thirty-two, the deficiency is in the laſt grinder.

The Teeth differ very much in figure from one another; but thoſe on the right ſide in each Jaw reſemble exactly thoſe on the left, ſo as to be in pairs; and the pairs belonging to the Upper-Jaw nearly reſemble the correſponding Teeth of the Lower-Jaw in ſituation, figure, and uſe *.

Each Tooth is divided into two parts, viz, firſt, the body, or that part of it which is the thickeſt, and ſtands bare beyond the Alveoli and Gums; ſecondly, the fang, or root, which is lodged within the Gum and Alveolar Proceſs: and the boundary between theſe two parts, which is graſped by the edge of the Gum, is called the Neck of a Tooth. The bodies of the different Teeth differ very much in ſhape and ſize, and ſo do their roots. The difference muſt be conſidered hereafter.

The Teeth of each Jaw are commonly divided into three claſſes, viz. *Inciſors*, *Canine*, and *Grinders*; but from conſidering ſome circumſtances of their form, growth and uſe, I chuſe to divide them into the four following claſſes, viz. *Inciſores*, commonly called Fore Teeth; *Cuſpidati*, vulgarly called *Canine*; *Bicuſpides*, or the two firſt Grinders; and *Molares*, or the three laſt Teeth. The number of each claſs, in each Jaw, for the moſt part, is four *Inciſores*, two *Cuſpidati*, four *Bicuſpides*, and four, five, or ſix *Molares*.

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* Vide Plate III. IV. V.

There is a regular gradation, both in growth and form through theſe claſſes, from the *Inciſores* to the *Molares*, in which reſpect the *Cuſpidati* are of a middle nature, between the *Inciſores* and *Bicuſpides*, as the laſt are between the *Cuſpidati* and *Molares*; and thence the *Inciſores* and *Molares* are the moſt unlike in every circumſtance * †.

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* Vide Plate III. and V.

† It is here to be underſtood, that the Teeth from which we take our deſcription, are ſuch as are juſt completely formed, and therefore not in the leaſt worn down by maſtication. Our deſcription of each claſs is taken from the Lower-Jaw; and the difference between them, and their correſponding claſſes in the Upper immediately follows that deſcription.

OF THE

INCISORES.

THE *Inciſores* are ſituated in the anterior part of the Jaw; the others more backwards on each ſide, in the order in which we have named them. The bodies of the *Inciſores* are broad, having two flat ſurfaces, one anterior, the other poſterior. Theſe ſurfaces meet in a ſharp cutting edge. The anterior ſurface is convex in every direction, and placed almoſt perpendicularly; and the poſterior is concave and ſloping, ſo that the cutting edge is almoſt directly over the anterior ſurface *.

Theſe ſurfaces are broadeſt and the Tooth is thinneſt at the cutting edge, or end of the Tooth, and thence they become gradually narrower and the Tooth thicker towards the neck, where the ſurfaces are continued to the narroweſt ſide, or edge of the fang. The body of an *Inciſor*, in a ſide-view, grows gradually thicker, or broader, from the edge or end of the Tooth to its neck; and theſe coincide with the flat, or broad ſide of the fang; ſo that when we look on the fore part, or on the back part of an *Inciſor*, we obſerve it grows conſtantly narrower from its cutting edge to the extremity of its fang. But in a ſide-view it is thickeſt or broadeſt at its neck, and thence becomes gradually more narrow, both to its cutting edge, and to the point of its fang *.

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* Vide Plate XIV. and Plate V. row 3, 4.

The Enamel is continued farther down, and is thicker on the anterior and back part of the *Inciſores* than on their ſides, and is even a little thicker on the fore part than upon the back part of the Tooth. If we view them laterally, either when intire, or when cut down through the middle, but eſpecially in the latter caſe, it would ſeem as if the fang was driven like a wedge into, and had ſplit the body or Enamel of the Tooth †. They ſtand almoſt perpendicularly, their bodies being turned a little forwards. Their fangs are much ſhorter than thoſe of the *Cuſpidati*, but pretty much of the ſame length with all the other Teeth of this Jaw ‡.

In the Upper-Jaw they are broader and thicker, eſpecially the two firſt: their length is nearly the ſame with thoſe of the Lower-Jaw. They ſtand a little obliquely, with their bodies turned much more forwards (the firſt eſpecially) and they generally fall over thoſe of the Under-Jaw.

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* Vide Plate V.

† Vide Plate XIV. Fig. 17.

‡ Vide Plate III. Fig. 2.

The two firſt *Inciſores* cover the two firſt, and half of the ſecond of the Lower-Jaw, ſo that the ſecond *Inciſor* in the Upper-Jaw covers more than half of the ſecond, and more than the half of the *Cuſpidatus* of the Under-Jaw *.

The edges of the *Inciſores* by uſe and friction, in ſome people, become blunt and thicker; and in others they ſharpen one another, and become thinner.

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* Vide Plate III. Fig. 1.

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OF THE

CUSPIDATUS.

THE *Cuſpidatus* is the next after the *Inciſores* in each Jaw; ſo that there are four of them in all. They are in general thicker than the *Inciſores*, and conſiderably the longeſt of all the Teeth *.

The ſhape of the body of the *Cuſpidatus* may be very well conceived, by ſuppoſing an *Inciſor*, with its corners rubbed off, ſo as to end in a narrow point, inſtead of a thin edge †; and the fang differs from that of an *Inciſor*, only in being much larger ‡.

The outſide of the body of a *Cuſpidatus* projects moſt at the ſide next the *Inciſores*, being there more angular than any where elſe.

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* Vide Plate VI. Fig. 1. Plate V. Row 1, 3d Fig. *bb*.

† Vide Plate IV. Fig. 1, at *bb*.

‡ Vide Plate VI. Fig. 1.

The Enamel covers more of the lateral parts of theſe Teeth than of the *Inciſores*; they ſtand perpendicularly, or nearly ſo, projecting farther out in the circle than the others, ſo that the two *Cuſpidati* and the four *Inciſores* often ſtand almoſt in a ſtraight line, eſpecially in the Lower-Jaw.

This takes place only in adults, and in them only when the ſecond Teeth are rather too large for the arch of the Jaw; for we never find this when the Teeth are at any diſtance from one another, or in young ſubjects. Their points commonly project beyond the horizontal line formed by the row of Teeth, and their fangs run deeper into the Jaws, and are oftener a little bent.

In the Upper-Jaw they are rather longer, and do not project much beyond the circle of the adjacent Teeth; and in this Jaw they are not placed vertically, their bodies being turned a little forwards and outwards.

When the Jaws are cloſed, the *Cuſpidatus* of the Upper-Jaw falls between, and projects a little over the *Cuſpidatus* and firſt *Bicuſpis* of the Lower-Jaw. When they are a little worn down by uſe, they commonly firſt take an edge ſomewhat like a worn *Inciſor*, and afterwards become rounder.

The uſe of the *Cuſpidati* would ſeem to be, to lay hold of ſubſtances, perhaps even living animals; they are not formed for dividing as the *Inciſores* are; nor are they fit for grinding. We may trace in theſe Teeth a ſimilarity in ſhape, ſituation, and uſe, from the moſt imperfectly carnivorous animal, which we believe to be the human ſpecies, to the moſt perfectly carnivorous, viz. the lion.

OF THE

BICUSPIDES.

IMmediately behind the *Cuſpidati*, in each Jaw, ſtand two Teeth, commonly called the firſt and ſecond Grinders, but which, for reaſons hinted at above, I ſhall ſuppoſe to conſtitute a particular claſs, and call them *Bicuſpides*.

Theſe (viz. the fourth and fifth Tooth from the ſymphyſis of the Jaw) reſemble each other ſo nearly, that a deſcription of the firſt will ſerve for both. The firſt indeed is frequently the ſmalleſt, and has rather the longeſt fang, having ſomewhat more of the ſhape of the *Cuſpidatus* than the ſecond.

The body of this Tooth is flattened laterally, anſwering to the flat ſide of the fang. It terminates in two points, viz. one external and one internal. The external is the longeſt and thickeſt; ſo that on looking into the mouth from without, this point only can be ſeen, and the Tooth has very much the appearance of a *Cuſpidatus*; eſpecially the firſt of theſe Teeth. The internal point is the leaſt, and indeed ſometimes ſo very ſmall, that the Tooth has the greateſt reſemblance to a *Cuſpidatus* in any view *. At the union of the points the Tooth is thickeſt, and thence it loſes in thickneſs, from ſide to ſide, to the extremity of the fang; ſo that the fang continues pretty broad to the point, and is often forked there. All the Teeth hitherto deſcribed often have their points bent, and more particularly the *Cuſpidati*.

The Enamel paſſes ſomewhat farther down externally and upon the inſide, than laterally; but this difference is not ſo conſiderable as in the *Inciſores*, and *Cuſpidati*; in ſome indeed it terminates equally all round the Tooth. They ſtand almoſt perpendicularly, but ſeem to be a little turned inwards, eſpecially the laſt of them.

In the Upper-Jaw they are rather thicker than in the Lower, and are turned a very little forwards and outwards. The firſt in the Upper-Jaw falls between the two in the Lower. The ſecond falls between the ſecond and the firſt Grinder: and both project over thoſe of the Lower-Jaw, but leſs than the *Inciſores* and *Cuſpidati*.

The *Bicuſpides*, and eſpecially the ſecond of them, in both Jaws, are oftener naturally wanting than any of the Teeth, except the *Dentes Sapientiæ*; thence we might conjecture that they are leſs uſeful; and this conjecture appears leſs improbable, when we conſider, that in their uſe they are of a middle nature between Cutters and Grinders; and that in moſt animals, ſo far as I have obſerved, there is a vacant ſpace between the Cutters and Grinders. I have alſo ſeen a Jaw in which the firſt *Bicuſpis* was of the ſame ſhape and ſize as a Grinder, and projected, for want of room, between the *Cuſpidatus* and ſecond *Bicuſpis*. Theſe and the Grinders alter very little in ſhape on their grinding ſurfaces by uſe; their points only wear down, and become obtuſe.

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* Vide Plate IV. Fig. 1, 2, *c c*.

OF THE

GRINDERS.

IN deſcribing the Grinders we ſhall firſt conſider the firſt and ſecond conjunctly, becauſe they are nearly the ſame in every particular; and then give an account of the third or laſt Grinder, which differs from them in ſome circumſtances.

The two firſt Grinders differ from the Bicuſpides, principally in being much larger, and in having more points upon their body, and more fangs *.

The body forms almoſt a ſquare, with rounded angles. The grinding ſurface has commonly five points, or protuberances, two of which are on the inner, and three on the outer part of the Tooth; and generally ſome ſmaller points at the roots of theſe larger protuberances. Theſe protuberances make an irregular cavity in the middle of the Tooth. The three outer points do not ſtand ſo near the outer edge of the Tooth, as the inner do on the inſide; ſo that the body of the Tooth

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* Vide Plate IV. Fig. 1, 2, *d d.*

ſwells out more from the points, or is more convex, on the outſide. The body towards its neck becomes but very little ſmaller, and there divides into two flat fangs, one forwards, the other backwards, with their edges turned outwards and inwards, and their ſides conſequently forwards and backwards: the fangs are but very little narrower at their ends, which are pretty broad, and often bifurcated. There are two cavities in each fang, one towards each edge, leading to the general cavity in the body of the Tooth. Theſe two cavities are formed by the meeting of the ſides of the fang in the middle, thereby dividing the broad and flat cavity into two *; and all along the outſide of theſe (and all the other flat fangs) there is a correſponding longitudinal groove. Theſe fangs at their middle, are generally bent a little backwards †.

The Enamel covers the bodies of theſe Teeth pretty equally all round.

The firſt Grinder is ſomewhat larger and ſtronger than the ſecond; it is turned a little more inwards than the adjacent *Bicuſpides*, but not ſo much as the ſecond Grinder. Both of them have generally ſhorter fangs than the *Bicuſpides*.

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* Vide Plate XIV. Fig. 7, where four dark ſpots are obſerved.

† Vide Plate VI. Fig. 1.

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There is a greater difference between theſe Grinders in the Upper and Lower-Jaw, than any of the other Teeth. In the Upper-Jaw they are rather rhomboidal, than ſquare in their body, with one ſharp angle turned forwards and outwards, the other backwards and inwards; beſides they have three fangs, which diverge, and terminate each in a point; theſe are almoſt round, and have but one cavity. Two of them are placed near each other perpendicularly, over the outſide of the Tooth; and the other, which generally is the largeſt, ſtands at a greater diſtance on the inſide of the Tooth, ſlanting inwards. In this Jaw theſe two Grinders are inclined outwards, and a little forwards; they project a little over the correſponding Teeth of the Lower-Jaw, and they are placed further back in the mouth, ſo that each is partly oppoſed to two of the Lower-Jaw. The ſecond in the Upper-Jaw is ſmaller than the others, and the firſt and ſecond are placed directly under the Maxillary Sinus. I once ſaw the ſecond Grinder naturally wanting on one ſide of the Lower-Jaw.

The third Grinder is commonly called *Dens Sapientiæ*; it is a little ſhorter and ſmaller than the others, and inclined a little more inwards and forwards. Its body is nearly of the ſame figure, but rather rounder, and its fangs are generally not ſo regular and diſtinct, for they often appear ſqueezed together; and ſometimes there is only one fang, which makes the Tooth conical: it is much ſmaller than the reſt of the Grinders. In the Upper-Jaw this Tooth has more variety than in the Lower, and is even ſmaller than the correſponding Tooth of the Lower, and thence ſtands directly oppoſed to it; but for this circumſtance the Grinders would reach farther back in the Upper-Jaw than in the Lower, which is not commonly the caſe.

In the Upper-Jaw this third Grinder is turned but a very little outwards; is frequently inclined ſomewhat backwards; and it projects over that of the Under-Jaw. It oftener becomes looſe than any of the other Teeth.

They are placed under the poſterior part of the Maxillary Sinus, and there the parts which compoſe the Sinus are thicker than in the middle. The variations as to the natural number of the Teeth, depend commonly upon theſe *Dentes Sapientiæ*.

Thus from the *Inciſores* to the firſt Grinder, the Teeth become gradually thicker at the extremity of their bodies, and ſmaller from the firſt Grinder to the *Dens Sapientiæ*. From the *Cuſpidatus* to the *Dens Sapientiæ* the fangs become much ſhorter; the *Inciſores* are nearly of the ſame length with the *Bicuſpides*. From the firſt *Inciſor* to the laſt Grinder, the Teeth ſtand leſs out from the ſockets and Gums.

The bodies of the Teeth in the Lower-Jaw are turned a little outwards at the anterior part of the Jaw, and thence, to the third Grinder, they are inclined gradually more inwards. The Teeth in the Upper-Jaw project over thoſe of the Under, eſpecially at the fore-part, which is owing to the greater obliquity of the Teeth in the Upper-Jaw; for the circle of the ſockets is nearly the ſame in both Jaws. This oblique ſituation, however, becomes gradually leſs, from the *Inciſores* backwards, to the laſt Grinder, which makes them gradually project leſs in the ſame proportion.

The Teeth in the Upper-Jaw are placed farther back in the circle than the correſponding Teeth of the Lower; this is owing to the two firſt *Inciſores* above being broader than the correſponding *Inciſores* below. All the Teeth have only one fang, except the Grinders, each of which has two in the Lower-Jaw, and three in the Upper *.

The fangs bear a proportion to the bodies of the Teeth; and the reaſon is evident, for otherwiſe they would have been eaſily broken, or puſhed out of their ſockets. The force commonly applied to them is oblique, not perpendicular; and they are not ſo firmly fixed in the Upper-Jaw, that is, the Alveolar Proceſs in that is not ſo ſtrong as in the Under-Jaw: it is perhaps on this account, that the Grinders in that Jaw have three fangs.

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* Thoſe Anatomiſts who allow the Teeth to have more fangs, have been led into a miſtake, I ſuppoſe, by often obſerving two canals in one fang; and thence concluded, that ſuch a fang was originally two, and that theſe were now grown together.

This particular ſtructure in the Alveolar Proceſs of the Upper-Jaw, is perhaps to give more room for the *Antrum Highmorianum*; on this ſuppoſition the fangs muſt be made accordingly, *i. e.* ſo that they ſhall not be puſhed into that cavity; now, by their diverging, they incloſe as it were the bottom of the *Antrum*, and do not puſh againſt its middle, which is the weakeſt part; and the points of three diverging fangs will make a greater reſiſtance (or not be ſo eaſily puſhed in) than if they were placed parallel. If there had been only two, as in the Lower-Jaw, they muſt have been placed oppoſite to the thinneſt part of the *Antrum*; and three points placed in any direction but a diverging one, would have had here much the ſame effect as two; and as the force applied is endeavouring to depreſs the Tooth, and puſh it inwards, the innermoſt fang diverges moſt, and is ſupported by the inner wall of the *Antrum*. That all this weakneſs in the Upper-Jaw is for the increaſe of the *Antrum* is probable, becauſe all the Teeth in the Upper-Jaw are a good deal ſimilar to thoſe in the Lower, excepting thoſe that are oppoſite to the Maxillary Sinus; and here they differ principally in the fangs, without any other apparent reaſon; and what confirms this, is, that the *Dentes Sapientiæ* in both Jaws are more alike than the other Grinders; for this reaſon, as I apprehend, becauſe the *Dens Sapientiæ* in the Upper-Jaw, does not interfere ſo much with the Maxillary Sinus.

What makes it ſtill more probable that the two firſt ſuperior Grinders have three fangs on account of the Maxillary Sinus, is, that the two Grinders on each ſide of the Upper-Jaw, in the child, have three fangs, and we find them underneath the *Antrum*; but thoſe that ſucceed them have only one fang, as in the Lower-Jaw; but by that time the *Antrum* has paſſed further back, or rather the arch of the Jaw has projected, or ſhot forwards, as it were, from under the *Antra*, ſo that the Alveolar Proceſſes that were under the *Antrum* at one age, are got before it in another.

That the edge of every fang is turned towards the circumference of the Jaw, in order to counteract the acting power, we ſhall ſee when we conſider the Motion of the Jaw, and the Uſe of the Teeth.

OF THE

ARTICULATION of the TEETH.

THE fangs of the Teeth are fixed in the Gum and Alveolar Proceſſes, by that ſpecies of Articulation called Gomphoſis, which, in ſome meaſure, reſembles a nail driven into a piece of wood *.

They are not, however, firmly united with the Proceſſes, for every Tooth has ſome degree of motion; and in heads which have been boiled or macerated in water, ſo as to deſtroy the Perioſteum and adheſion of the Teeth, we find the Teeth ſo looſely connected with their ſockets, that all of them are ready to drop out, except the Grinders, which remain as it were hooked from the number and ſhape of their fangs.

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[*] Vide Plate I. for the ſockets; and Plate VI. for the Teeth themſelves in their ſockets.

OF

THE GUMS.

THE Alveolar Proceſſes are covered by a red vaſcular ſubſtance, called the Gums, which has as many perforations as there are Teeth; and the neck of a Tooth is covered by, and fixed to this Gum. Thence there are fleſhy partitions between the Teeth, paſſing between the external and internal Gum, and, as it were, uniting them; theſe partitions are higher than the other parts of the Gum, and thence form an arch between every two adjacent Teeth. The thickneſs of that part of the Gum which projects beyond the ſockets is conſiderable; ſo that when the Gum is corroded by diſeaſe, by boiling, or otherwiſe, the Teeth appear longer, or leſs ſunk into the Jaw. The Gum adheres very firmly in a healthful ſtate both to the Alveolar Proceſs and to the Teeth, but its extreme border is naturally looſe all around the Teeth. The Gum, in ſubſtance, has ſomething of a cartilaginous hardneſs and elaſticity, and is very vaſcular, but ſeems not to have any great degree of ſenſibility; for though we often wound it in eating, and in picking our Teeth, yet we do not feel much pain upon theſe occaſions; and both in infants and old people, where there are no Teeth, the Gums bear a very conſiderable preſſure, without pain.

The advantage ariſing from this degree of inſenſibility in the Gums is obvious, for till the child cuts its Teeth, the Gums are to do the buſineſs of Teeth, and are therefore formed for this purpoſe, having a hard ridge running through their whole length. Old people, who have loſt their Teeth, have not this ridge. When in a ſound ſtate, the Gums are not eaſily irritated by being wounded, and therefore are not ſo liable to inflammation as other parts, and ſoon heal.

The Teeth being united to the Jaw by the Perioſteum and Gum, have ſome degree of an yielding motion in the living body. This circumſtance renders them more ſecure; it breaks the jar of bony contact, and prevents fractures both of the ſockets and of the Teeth themſelves.

OF THE

ACTION of the TEETH, ariſing from the Motion of the Lower-Jaw.

THE Lower-Jaw may be ſaid to be the only one that has any motion in maſtication; for the Upper-Jaw can only move with the other parts of the head. That the Upper-Jaw and head ſhould be raiſed in the common act of opening the mouth, or chewing, would ſeem, at firſt ſight, improbable; and from an attentive view of the mechaniſm of the joints and muſcles of thoſe parts, from experiment and obſervation, we find that they do not ſenſibly move. We ſhall only mention one experiment in proof of this, which ſeems concluſive: let a man place himſelf near ſome fixed point, and look over it, to another diſtant and immoveable object, when he is eating. If his head ſhould riſe in the leaſt degree, he would ſee more of the diſtant object over the neareſt fixed point, which in fact he does not. The nearer the fixed point is, and the more diſtant the object, the experiment will be more accurate and convincing. The reſult of the experiment will be the ſame, if the neareſt point has the ſame motion with the head; as, when he looks from under the edge of a hat, or any thing elſe put upon his head, at ſome diſtant fixed object. We may conclude then that the motion is entirely in the Lower-Jaw: and, as we have already deſcribed both the articulation and the motion of the bone, we ſhall now explain the action of maſtication, and, at the ſame time, conſider the uſe of each claſs of Teeth.

With regard to the action of the Teeth of both Jaws, in maſtication, we may obſerve, once for all, that their action and re-action muſt be always equal, and that the Teeth of the Upper and Lower-Jaws are complete, and equal antagoniſts both in cutting and grinding.

When the Lower-Jaw is depreſſed, the Condyles ſlide forwards on the eminences; and they return back again into the cavities, when the Jaw is completely raiſed.

This ſimple action produces a grinding motion of the Lower-Jaw, backwards on the Upper, and is uſed when we divide any thing with our fore Teeth, or *Inciſores*. For this purpoſe, the *Inciſores* are well formed; as they are higher than the others, their edges muſt come in contact ſooner; and as the Upper project over the Under, we find in dividing any ſubſtance with them, that we firſt bring them oppoſite to one another, and as they paſs through the part to be divided, the Lower-Jaw is brought back, while the Inciſors of that Jaw ſlide up behind thoſe of the Upper-Jaw, and of courſe paſs by one another. In this way they complete the diviſion, like a pair of ſciſſars ; and at the ſame time they ſharpen one another. There are exceptions to this ; for theſe Teeth in ſome people meet equally, viz. in thoſe people whoſe Fore-Teeth do not project further from the Gum, or ſocket, than the back Teeth ; and ſuch Teeth are not ſo fit for dividing ; and in ſome people the Teeth of the Lower-Jaw are ſo placed, as to come before thoſe of the Upper-Jaw ; this ſituation is as favourable for cutting as when the over-lapping of the Teeth is the reverſe, except for this circumſtance, that the Lower-Jaw muſt be longer, and therefore its action weaker.

The other motion of the Lower-Jaw, viz. when the lateral Teeth are uſed, is ſomewhat different from the former. In opening the mouth, one Condyle ſlides a little forwards, and the other ſlides a little further back into its cavity ; this throws the Jaw a little to that ſide, juſt enough to bring the lower Teeth directly under their correſponding Teeth in the Upper-Jaw : this is done, either in dividing, or holding of ſubſtances ; and theſe are the Teeth that are generally uſed in the laſt mentioned action. When the true grinding motion is to be performed, a greater degree of this laſt motion takes place ; that is, the Condyle of the oppoſite ſide is brought farther forwards, and the Condyle of the ſame ſide is drawn farther back into the cavity of the Temporal Bone, and the Jaw is a little depreſſed.

ed. This is only preparatory for the effect to be produced; for the moving back of the firſt mentioned Condyle into the ſocket, is what produces the effect in maſtication.

The lateral Teeth in both Jaws are adapted to this oblique motion; in the Lower they are turned a little inwards, that they may act more in the direction of their axis; and here the Alveolar Proceſs is ſtrongeſt upon the outſide, being there ſupported by the ridge at the root of the Coronoid Proceſs. In the Upper-Jaw the obliquity of the Teeth is the reverſe, that is, they are turned outwards, for the ſame reaſon; and the longeſt fang of the Grinders is upon the inſide, where the ſocket is ſtrengthened by the bony partition between the *antrum* and noſe. Hence it is, that the Teeth of the Lower-Jaw have their outer edges worn down firſt; and, *vice verſa*, in the Upper-Jaw.

GENE-

GENERAL COMPARISONS

BETWEEN THE

MOTION of the JAW in young and in old People.

IN children who have not yet Teeth, there does not ſeem to be a ſliding motion in the Lower-Jaw. The articular eminence of the Temporal Bone is not yet formed, and the cavity is not larger than the Condyle; therefore the center of motion in ſuch, muſt be in the Condyle. In old people, who have loſt their Teeth, the centre of motion appears to be in the Condyles, and the motion of their Jaw to be only depreſſion and elevation. They never depreſs the Jaw ſufficiently to bring the Condyle forwards on the eminence, becauſe in them the mouth is ſufficiently opened when the Jaw is in its natural poſition.

Hence it is that in old people, the gums of the two Jaws do not meet in the fore-part of the mouth *, and they cannot bite at that part ſo well, as at the ſide of the Jaw; and, inſtead of the grinding motion, which

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* Vide Plate VII. where the Symphyſis of the Lower-Jaw, when the mouth is ſhut, projects conſiderably farther forwards than that of the Upper.

would be uſeleſs, where there are no Grinders; they bruiſe their food rather by a ſimple motion of the Jaw upwards and downwards.

It is from the want of Teeth in both thoſe ages, that the face is ſhorter in proportion to its breadth. In an old perſon, after the Teeth are gone, the face is ſhorter, while the mouth is ſhut, by almoſt the whole lengths of the Teeth in both Jaws; that is, about an inch and an half.

From the want of Teeth too, at both thoſe ages, the cavity of the mouth is then ſmaller; and the tongue ſeems too large and unmanageable, more eſpecially in old people. In theſe laſt we obſerved alſo, that the chin projects forwards, in proportion as the mouth is ſhut; becauſe the baſis of the Lower-Jaw (which is all that now remains) deſcribes a wider circle than the Alveolar Proceſs in younger people. The Jaws do not project ſo much forwards in a child, as in an adult; hence the face is flatter, eſpecially at the lower part. In proportion as the laſt Grinders are produced, the ſides of the curve formed by the Jaws become longer, and puſh forward the fore-part, none of the additional part paſſing backwards. The fore-part alſo continues nearly of the ſame ſize, ſo that the whole Jaw is longer in proportion to its breadth, and projects farther forwards.

OF THE

FORMATION of the ALVEOLAR PROCESS.

HAVING conſidered the Alveolar Proceſſes in their adult, or perfect ſtate, we ſhall next examine and trace them from their beginning.

We obſerve the beginning of the Alveolar Proceſs at a very early period. In a fœtus of three or four months it is only a longitudinal groove, deeper and narrower forwards, and becoming gradually more ſhallow and wider backwards: inſtead of bony partitions, dividing that groove into a number of ſockets, there are only ſlight ridges acroſs the bottom and ſides, with intermediate depreſſions, which mark the future *Alveoli* *.

In the Lower-Jaw the veſſels and nerves run along the bottom of this Alveolar cavity, in a ſlight groove, which afterwards becomes a complete and diſtinct bony canal.

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* Vide Plate VIII. Fig. 1, 2.

The Alveolar Proceſs grows with the Teeth, and for ſome time keeps the ſtart of them. The ridges which are to make the partitions ſhoot from the ſides acroſs the canal, at the mouth of the cell, forming hollow arches: this change happens firſt at the anterior parts of the Jaws [*]. As each cell becomes deeper, its mouth alſo grows narrower, and at length is almoſt, but not quite, cloſed over the contained Tooth.

The diſpoſition for contracting the mouth of the cell, is chiefly in the outer plate of the bone, which occaſions the contracted orifices of the cells to be nearer the inner edge of the Jaw. The reaſon, perhaps, why the bone ſhoots over, and almoſt covers the Tooth, is that the Gum may be firmly ſupported before the Teeth have come through.

The *Alveoli* which belong to the adult Grinders, are formed in another manner; in the Lower-Jaw they would ſeem to be the remains of the root of the Coronoid Proceſs [‡]; for the cells are formed for thoſe Teeth in the root of that Proceſs; and in proportion as the body of the bone, and the cells already formed, puſh forwards from under that Proceſs, the ſucceeding cells and their Teeth are formed, and puſhed forward in the ſame manner.

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[*] Vide Plate VIII. Fig. 1, 2, 3, 4, 5, and 6.

[†] Vide Plate VIII. Fig. 7, which is moſt remarkable in thoſe of the Grinders; as theſe Alveoli are not opened for the exit of the Teeth.

[‡] Vide Plate X. Fig 1.

In the Upper-Jaw there are cells formed in the tubercles for the young Grinders, which at firſt are very ſhallow, and become deeper and deeper as the Teeth grow; and they grow ſomewhat faſter, ſo as almoſt to incloſe the whole Tooth before it is ready to puſh its way through that incloſure and Gum *. There is a ſucceſſion of theſe, till the whole three Grinders are formed.

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* Vide Plate I. Fig. 10.

OF

OF THE

FORMATION of the TEETH in the FOETUS.

THE depreſſion, or firſt rudiments of the *Alveoli* obſervable in a Fœtus of three or four months, is filled with four or five little pulpy ſubſtances, which are not very diſtinct at this age. About the fifth month both the proceſſes themſelves and the pulpy ſubſtances become more diſtinct; the anterior of which are the moſt complete. About this age too the oſſifications begin on the edge of the firſt *Inciſores*. The *Cuſpidati* are not in the ſame circular line with the reſt, but ſomewhat on the outſide, making a projection there at this age, there not being ſufficient room for them.

In the ſixth, or ſeventh month, the edges, or tips, of all theſe five ſubſtances are begun to oſſify, and the firſt of them is a little advanced *; and beſides theſe, the pulp of the ſixth Tooth has begun to be formed; it is ſituated in the tubercle of the Upper-

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* Vide Plate X. Fig. 4, 5, where theſe oſſifications are repreſented.

Jaw, and under and on the inſide of the Coronoid Proceſs in the Lower-Jaw: ſo that at this age, in both Jaws, there are in all twenty Teeth begun to oſſify, and the *ſtamina* of twenty-four. They may be divided into the *Inciſores*, *Cuſpidati*, and *Molares*; for at this age there are no *Bicuſpides*, the two laſt teeth in each ſide of both Jaws having all the characteriſtics, and anſwering all the purpoſes of the true *Molares* in the adult, though when theſe firſt *Molares* fall out, their places are taken by the *Bicuſpides*.

The Teeth gradually advance in their oſſification, and about the ſeventh, eighth, or ninth month after birth, the *Inciſores* begin to cut or paſs through the Gums; firſt, generally, in the Lower-Jaw. Before this time the oſſificationsin the third Grinder, or that which makes the firſt in the adult, are begun *.

The *Cuſpidatus* and *Molares* of the Fœtus are not formed ſo faſt as the *Inciſores*; they generally all appear nearly about the ſame time, viz. about the twentieth, or twenty-fourth month; however, the firſt Grinder is often more advanced within the ſocket than the *Cuſpidatus*, and moſt commonly appears before it.

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* Vide Plate X. Fig. 6, where the firſt Inciſors had cut the Gum, and where the third Grinder in the child, or firſt in the adult, was begun to oſſify.

Theſe twenty are the only Teeth that are of uſe to the child from the ſeventh, eighth, or ninth month, till the twelfth or fourteenth year. Theſe are called the Temporary, or Milk Teeth, becauſe they are all ſhed between the years of ſeven and fourteeen, and are ſupplied by others.

OF THE

CAUSE of PAIN in DENTITION.

THESE twenty Teeth, in cutting the Gum, give pain, and produce many other ſymptoms which often prove fatal to children in Dentition. It has been gerally ſuppoſed that theſe ſymptoms ariſe from the Tooth's preſſing upon the inſide of the Gum, and working its way mechanically; but the following obſervations ſeem to be nearer the truth.

The Teeth, when they begin to preſs againſt the Gum, irritate it, and commonly give pain. The Gums are then affected with heat, ſwelling, redneſs, and the other ſymptoms of inflammation. The Gum is not cut through by ſimple or mechanical preſſure, but the irritation and conſequent inflammation produces a thinning, or waſting of the Gum at this part: for it often happens that when an extraneous, or a dead ſubſtance, is contained in the body, that it produces a deſtruction of the part between it, and that part of the ſkin which is neareſt it, and ſeldom of the other parts, excepting thoſe between it and the ſurface of a cavity opening externally, and that by no means ſo frequently;

quently. And in thoſe caſes there is an abſorption of the ſolids, or of the part deſtroyed, not a melting down, or ſolution of them into Pus. The Teeth are to be looked upon as extraneous bodies, with reſpect to the Gum, and as ſuch they irritate the inſide of that part in the ſame manner as the Pus of an abſceſs, an exfoliation of a bone, or any other extraneous body; and therefore produce the ſame ſymptoms, excepting only the formation of matter. If, therefore, theſe ſymptoms attend the cutting of the Teeth, there can be no doubt of the propriety of opening the way for them; nor is it ever, as far as I have obſerved, attended with any dangerous conſequence.

OF THE

FORMATION and PROGRESS of the ADULT TEETH.

HAVING now conſidered the firſt formation, and the progreſs of the Temporary Teeth, we ſhall next deſcribe the formation of thoſe Teeth which are to ſerve through life.

In this enquiry, to avoid confuſion, I ſhall confine the deſcription to the Teeth in the Lower-Jaw; for the only difference between thoſe in the two Jaws, is in the time of their appearance, and generally it is later in the Upper-Jaw. Their formation and appearance proceeds not regularly from the firſt *Inciſor* backwards to the *Dens Sapientiæ*, but it begins at two points on each ſide of both Jaws, viz. at the firſt *Inciſor*, and at the firſt *Molaris*. The Teeth between theſe two points make a quicker progreſs than thoſe behind.

The Pulp of the firſt adult *Inciſor*, and of the firſt adult *Molaris* begin to appear in a Fœtus of ſeven or eight months, and five or ſix months after birth the oſſification begins in them; ſoon after birth the Pulp of the ſecond *Inciſor* and *Cuſpidatus* begin to be formed, and about eight or nine months afterwards they begin to oſſify; about the fifth or ſixth year the firſt *Bicuſpis* appears; about the ſixth or ſeventh the ſecond *Bicuſpis*, and the ſecond *Molaris*; and about the twelfth, the third *Molaris*, or *Dens Sapientiæ*.

The firſt five may be called the permanent Teeth: they differ from the temporary in having larger fangs. The permanent *Inciſores* and *Cuſpidati* are much thicker and broader, and the *Molares* are ſucceeded by *Bicuſpides*, which are ſmaller, and have but one fang.

All theſe permanent or ſucceeding Teeth are formed in diſtinct *Alveoli* of their own; ſo that they do not fill up the old ſockets of the temporary Teeth, but have their new *Alveoli* formed as the old *ones* decay [*].

The firſt *Inciſor* is placed on the inſide of the root of the correſponding temporary Tooth, and deeper in the Jaw. The ſecond *Inciſor* and the *Cuſpidatus* begin to be formed on the inſide, and ſomewhat under the temporary ſecond *Inciſor* and *Cuſpidatus*. Theſe three are all ſituated much in the ſame manner, with reſpect to the firſt ſet; but as they are larger, they are placed ſomewhat farther back in the circle of the Jaw.

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[*] Vide Plate X. Fig. 1, 2, and 3.

The firſt *Bicuſpis* is placed under, and ſomewhat farther back than the firſt temporary Grinder, or fourth Tooth of the child.

The ſecond *Bicuſpis* is placed immediately under the ſecond temporary Grinder.

The ſecond *Molaris* is ſituated in the lengthening tubercle in the Upper-Jaw, and directly under the Coronoid Proceſs in the Lower.

The third *Molaris*, or *Dens Sapientiæ*, begins to form immediately under the Coronoid Proceſs.

The firſt Adult *Molaris* comes to perfection, and cuts the Gum about the twelfth year of age, the ſecond about the eighteenth, and the third, or *Dens Sapientiæ*, from the twentieth to the thirtieth: ſo that the *Inciſores* and *Cuſpidati* require about ſix or ſeven years, from their firſt appearance, to come to perfection; the *Bicuſpides* about ſeven or eight; and the *Molares* about twelve.

It ſometimes happens that a third ſet of Teeth appears in very old people; when this does happen, it is in a very irregular manner, ſometimes only one, at other times more, and now and then a complete ſet comes in both Jaws. I never ſaw an inſtance of this kind but once, and there two fore Teeth ſhot up in the Lower-Jaw.

I ſhould ſuppoſe that a new Alveolar Proceſs muſt be alſo formed in ſuch caſes, in the ſame manner as in the production of the firſt and ſecond ſets of Teeth. From what I can learn, the age at which this happens is generally about ſeventy. From this circumſtance, and another that ſometimes happens to women at this age, it would appear that there is ſome effort in nature to renew the body at that period.

When this ſet of Teeth which happens ſo late in life, is not complete, eſpecially where they come in one Jaw, and not in the other, they are rather hurtful than uſeful; for in that caſe we are obliged to pull them out, as they only wound the oppoſite Gum.

THE

MANNER in which a TOOTH is formed.

THE body of the Tooth is formed firſt, afterwards the Enamel and Fangs are added to it. All the Teeth are produced from a kind of pulpy ſubſtance, which is pretty firm in its texture, tranſparent, excepting at the ſurface, where it adheres to the Jaw, and has at firſt the ſhape of the bodies of the Teeth which are to be formed from it *. Theſe pulpy ſubſtances are very vaſcular, they adhere only at one part to the Jaw, viz. at the bottom of the cavity which is to form the ſocket ; and at that place their veſſels enter ; ſo that they are prominent, and ſomewhat looſe in the bony cavity which lodges them.

They grow nearly as large as the body of the Tooth before the oſſification begins, and increaſe a little for ſome time after the oſſification is begun. They are ſurrounded by a membrane, which is not connected with them, excepting at their root or ſurface of adheſion.

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* Vide Plate XII. Fig. 4, 5, 6.

This membrane adheres by its outer ſurface all around the bony cavity in the Jaw, and alſo to the gum where it covers the Alveoli.

When the pulp is very young, as in the Fœtus of ſix or ſeven months, this membrane itſelf is pretty thick and gelatinous *. We can examine it beſt in a new-born child, and we find it made up of two *lamellæ*, an external and internal: the external is ſoft and ſpongy, without any veſſels; the other is much firmer, and extremely vaſcular, its veſſels coming from thoſe that are going to the pulp of the Tooth: it makes a kind of Capſula for the pulp and body of the Tooth. While the Tooth is within the gum, there is always a mucilaginous fluid, like the Sinovia in the joints, between this membrane and the pulp of the Tooth.

When the Tooth cuts the gum, this membrane likewiſe is perforated; after which it begins to waſte, and entirely gone by the time the Tooth is fully formed, for the lower part of the membrane continues to adhere to the neck of the Tooth, which has now riſen as high as the edge of the gum.

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* Vide Plate XII. Fig. 1, 2.

OF THE

OSSIFICATION of a TOOTH upon the PULP.

THE beginning of the oſſification upon the pulp is by one point, or more, according to the kind of Tooth. In the *Inciſores* it is generally by three points, the middle one being the higheſt, and the firſt that begins to oſſify. The *Cuſpidatus* begins by one point only; the *Bicuſpis* by two, one external, which is the firſt and the higheſt, and the other internal. The *Molares*, either in a child, or an adult, begin by four or five oſſifications, one on each point, the external always the firſt *. Where the Teeth began to oſſify at one point only, that oſſification gradually advances till the Tooth is entirely completed †; but if there are more than one point of oſſification, each oſſification increaſes till their baſis come in contact with one another, and there all unite into one ‡; after which they advance in growth as one oſſification.

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* Vide Plate X. Fig. 4, where ſome of the diſtinct oſſifications may be obſerved.

† Vide Plate XIII. Fig. 1, 2, 3, &c.

‡ Vide Plate X. Fig. 5.

The oſſifications in their progreſs become thicker and thicker where they firſt began, but increaſe faſter on the edges of the Teeth; ſo as thence to become more and more hollow, and the cavity becomes deeper [*]. As the oſſification advances, it gradually ſurrounds the Pulp till the whole is covered by bone, excepting the under ſurface: and while the oſſifications advance, that part of the Pulp which is covered by bone is always more vaſcular than the part which is not yet covered [†].

The adheſion of the Pulp to the new-formed Tooth, or bone, is very ſlight, for it can always be ſeparated from it without any apparent violence, nor are there any veſſels going from the one to the other; the place, however, where it is moſt ſtrongly attached is round the edge of the bony part, which is the laſt part formed. When the bone has covered all the Pulp, it begins to contract a little, and becomes ſomewhat rounded, making that part of the Tooth which is called the neck; and from this place the fangs begin [‡]. When the fangs form, they puſh up the bodies of the Teeth through the ſockets, which waſte, and afterwards through the Gum, which alſo waſtes, as has been explained upon the cutting of the Teeth; for before this time the riſing of the Teeth is ſcarce obſervable, as the Pulp was at firſt nearly of the ſize of the body of the Tooth itſelf, and waſted nearly in proportion to the increaſe of the whole oſſification.

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[*] Vide Plate XIII. Fig. *a*, *b*, *c*, *d*, two rows of Inciſors ſawed down the middle, the higheſt of the child, the other of the adult; *c*, *f*, *g*, two rows of Grinders ſhewing the ſame circumſtances.

[†] Vide Plate XII. Fig. 5, 6.

[‡] Vide Plate XIII. Fig 1. 2, 3, &c.

The Pulp has originally no proceſs anſwering to the fang *; but as the cavity in the body of the Tooth is filled up by the oſſification, the pulp is lengthened into a fang. The fang grows in length, and riſes higher and higher in the ſocket, till the whole body of the Tooth is puſhed out. The ſocket, at the ſame time, contracts at its bottom, and graſps the neck, or beginning fang, adheres to it, and riſes with it, which contraction is continued through the whole length of the ſocket as the fang riſes; or the ſocket which contained the body of the Tooth, being too large for the fang, is waſted or abſorbed into the conſtitution, and a new Alveolar portion is raiſed with the fang; whence in reality the fang does not ſink, or deſcend into the Jaw. Both in the body, and in the fang of a growing Tooth, the extreme edge of the oſſification is ſo thin, tranſparent, and flexible, that it would appear rather to be horny than bony, very much like the mouth or edge of the ſhell of a ſnail when it is growing: and indeed it would

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[*] Vide Plate XII. Fig. 1, 4, 5, and 6.

ſeem to grow much in the ſame manner[*], and the oſſified part of a Tooth would ſeem to have much the ſame connection with the pulp as a ſnail has with its ſhell.

As the Tooth grows, its cavity becomes gradually ſmaller, eſpecially towards the point of the fang. In tracing the formation of the fang of a Tooth, we hitherto have been ſuppoſing it to be ſingle, but where there are two, or more, it is ſomewhat different, and more complicated.

When the body of a Molares is formed, there is but one general cavity in the body of the Tooth, from the brim of which the oſſification is to ſhoot, ſo as to form two or three fangs [†]. If two only, then the oppoſite parts of the brim of the cavity of the Tooth ſhoot acroſs where the Pulp adheres to the Jaw, meet in the middle, and thereby divide the mouth of the cavity into two openings [‡]; and from the edges of theſe two openings the two fangs grow [§].

We often find that a diſtinct oſſification begins in the middle of the general cavity upon the root of the

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[*] Vide Plate XIII. Fig. 1, 2, 3, or Fig.

[†] Vide Plate XIII. Fig. 1, *a a*.

[‡] Vide Plate XIII. Fig. *b*.

[§] Vide Plate XIII. Fig. *c d e*.

Pulp, and two proceſſes coming from the oppoſite edges of the bony ſhell join it; which anſwers the ſame purpoſe.

When there are three fangs, we ſee three proceſſes coming from ſo many points of the brim of the cavity, which meet in the center, and divide the whole into three openings *; and from theſe are formed the three fangs †. We often find the fangs forked at their points, eſpecially in the *Bicuſpides*. In this caſe, the ſides of the fang as it grows, come cloſe together in the middle, making a longitudinal groove on the outſide; and this union of the oppoſite ſides divides the mouth of the growing fang into two orifices, from which the two points are formed.

By the obſervations which I have made in unravelling the texture of the Teeth, when ſoftened by an acid, and from obſerving the diſpoſition of the red parts in the Tooth of growing animals, interruptedly fed with madder, I find that the bony part of a Tooth is formed of *Lamellæ*, placed one within another. The outer *Lamellæ* is the firſt formed, and is the ſhorteſt: the more internal *Lamellæ* lengthen gradually towards the fang, by which means, in proportion as the Tooth grows longer, its cavity grows ſmaller, and its ſides grow thicker *.

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* Vide Plate XIII. Fig. *f*, *g*.

† Vide Plate XIII. Fig. *h*, *i*, *k*.

How the earthy and animal ſubſtance of the Tooth is depoſited on the ſurface of the pulp is not perhaps to be explained.

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* Vide Plate XII. Fig. 7, 8.

OF THE

FORMATION of the ENAMEL.

IN ſpeaking of the Enamel we poſtponed treating of its Formation, till it could be more clearly underſtood; and now we ſhall previouſly deſcribe ſome parts which we apprehend to be ſubſervient to its formation, much in the ſame manner as the Pulp is to the body of the Tooth.

From its ſituation, and from the manner in which the Teeth grow, one would imagine that the Enamel is firſt formed; but the bony part begins firſt, and very ſoon after the Enamel is formed upon it. There is another pulpy ſubſtance oppoſite to that which we have deſcribed; it adheres to the inſide of the Capſula, where the Gum is joined to it, and its oppoſite ſurface lies in contact with the baſis of the above deſcribed Pulp, and afterwards with the new formed baſis of the Tooth: whatever eminences or cavities the one has, the other has the ſame, but reverſed, ſo that they are moulded exactly to each other.

In the *Inciſores* it lies in contact not with the ſharper cutting edge of the Pulp, or Tooth, but againſt the hollowed inſide of the Tooth; and in the *Molares* it is placed directly againſt their baſe, like a Tooth of the oppoſite Jaw. It is thinner than the other Pulp, and decreaſes in proportion as the Teeth advance. It does not ſeem to be very vaſcular. The beſt time for examining it is in a Fœtus of ſeven or eight months old.

In the granivorous animal, ſuch as the horſe, cow, &c. whoſe Teeth have the Enamel intermixed with the bony part*, and whoſe Teeth, when forming, have as many interſtices as there are continuations of the Enamel, we find proceſſes from the Pulp paſſing down into thoſe interſtices as far as the Pulp which the Tooth is formed from, and there coming into contact with it.

After the points of the firſt deſcribed Pulp are begun to oſſify, a thin covering of enamel is ſpread over them, which increaſes in thickneſs till ſome time before the Tooth begins to cut the Gum.

The Enamel appears to be ſecreted from the Pulp above deſcribed, and perhaps from the Capſula which incloſes the body of the Tooth. That it is from the Pulp and Capſula ſeems evident in the horſe, aſs, ox, ſheep, &c. therefore we have little reaſon to doubt of it in the human ſpecies. It is a calcareous earth, probably diſſolved in the juices of our body, and thrown out from theſe parts which act here as a gland. After it is ſecreted, the earth is attracted by the bony part of the Tooth, which is already formed; and upon that ſurface it cryſtallizes.

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* Vide Plate XIV. Fig. 19, 20.

The operation is ſimilar to the formation of the ſhell of the egg, the ſtone in the kidneys and bladder, and the gall ſtone. This accounts for the ſtriated cryſtallized appearance which the Enamel has when broken, and alſo for the direction of theſe *Striæ* *.

The Enamel is thicker at the points and baſis than at the neck of the Teeth, which may be eaſily accounted for from its manner of formation; for if we ſuppoſe it to be always ſecreting, and laid equally over the whole ſurface, as the Tooth grows, the firſt formed will be the thickeſt; and the neck of the Tooth, which is the laſt formed part incloſed in this Capſula, muſt have the thinneſt coat; and the fang, where the *Perioſteum* adheres, and leaves no vacant ſpace, will have none of the Enamel.

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* The Author has made many experiments on the formation of different *Calculi*, and finds they are formed by cryſtallization, which were communicated to his brother, and taught by him to his pupils in 1761, and which he propoſes to give to the Public as ſoon as his time will permit.

At its firſt formation it is not very hard; for by expoſing a very young Tooth to the air, the Enamel cracks, and looks rough: but by the time that the Teeth cut the Gum, the Enamel ſeems to be as hard as ever it is afterward; ſo that the air ſeems to have no effect in hardening it.

OF THE

MANNER of SHEDDING of TEETH.

AN opinion has commonly prevailed, that the firſt ſet of Teeth are puſhed out by the ſecond; this, however, is very far from being the caſe: and were it ſo, it would be attended with a very obvious inconvenience; for, were a Tooth puſhed out by one underneath, that Tooth muſt riſe in proportion to the growth of the ſucceeding one, and ſtand in the ſame proportion above the reſt. But this circumſtance never happens: neither can it; for, the ſucceeding Teeth are formed in new and diſtinct ſockets, and generally the *Inciſores* and the *Cuſpidati* of the ſecond ſet are ſituated on the inſide of the correſponding teeth of the firſt ſet *; and we find, that in proportion to the growth of the ſucceeding Teeth, the fangs of the firſt ſet decay, till the whole of the fang is ſo far deſtroyed, that nothing remains but the neck, or that part of the fang to which the Gum adheres †, and then the leaſt force puſhes the Tooth out. It would be very natural to ſuppoſe, that this was owing to a conſtant preſſure from the riſing Teeth againſt the fangs or ſockets of the firſt ſet: but it is not ſo; for, the new Alveoli riſe with the new Teeth, and the old Alveoli decay in proportion as the fangs of the old Teeth decay, and when the firſt ſet falls out, the ſucceeding Teeth are ſo far from having deſtroyed, by their preſſure, the parts againſt which they might be ſuppoſed to puſh, that they are ſtill incloſed, and covered by a complete bony ſocket. From this we ſee, that the change is not produced by a mechanical preſſure, but is a particular proceſs in the animal œconomy.

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* Vide Plate X. Fig. 2, 3.

* Vide Plate XV. which ſhews the gradual decay in the ſingle and double Teeth, and alſo in one Grinder of a horſe.

I have ſeen two or three Jaws where the ſecond temporary Grinders were ſhedding in the common way, without any Tooth underneath; and in one Jaw, where both the Grinders were ſhedding, I met with the ſame circumſtance.

A remarkable inſtance of this ſort occurred to me in a lady who deſired me to look at a looſe Tooth, which I found was the laſt temporary Tooth not yet ſhed. I deſired that it might be drawn out, and told her it was of no uſe, and could not by any art be fixed, as it was one of the Teeth that is naturally ſhed, and that another might come in its place: however ſhe was diſappointed.

Theſe caſes prove evidently, that in ſhedding, the firſt Teeth are not puſhed out by the ſecond ſet, but that they grow looſe, and fall out of their own accord. That the ſucceeding Teeth have ſome influence on the ſhedding of the temporary ſet is proved by thoſe very caſes; ſince in one of the firſt mentioned the perſon was above twenty years of age, and in the other the lady was thirty; and it is reaſonable to believe, that the ſhedding of theſe Teeth was ſo late in thoſe inſtances, from the want of the influence, whatever it is, of the new Teeth. When the *Inciſores* and *Cuſpidati* of the new ſet are a little advanced, but long before they appear through their bony ſockets, there are ſmall holes leading to them on the inſide, or behind the temporary ſockets and Teeth; and theſe holes grow larger and larger, till at laſt the body of the Tooth paſſes quite through them.

OF THE
GROWTH of the TWO JAWS.

AS a knowledge of the manner in which the two Jaws grow, will lead to the better underſtanding the ſhedding of the Teeth; and as the Jaws ſeem to differ in their manner of growing, from other bones, and alſo vary according to the age, it will be here proper to give ſome account of their growth.

In a Fœtus three or four months old, we have deſcribed the marks of four or five Teeth, which occupy the whole length of the Upper-Jaw, and all that part of the Lower which lies before the Coronoid Proceſs, for the fifth Tooth is ſomewhat under that proceſs *.

Theſe five marks become larger, and the Jaw bones of courſe increaſe in all directions, but more conſiderably backwards; for in a Fœtus of ſeven or eight months, the marks of ſix Teeth in each ſide of both Jaws are to be obſerved, and the ſixth ſeems to be in the place where the fifth was; ſo that in theſe laſt four

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* Vide Plate VIII. Fig. 1, 2.

months the Jaw has grown in all directions in proportion to the increaſed ſize of the Teeth, and beſides has lengthened itſelf at its poſterior end as much as the whole breadth of the ſocket of that ſixth Tooth *.

The Jaw ſtill increaſes in all points till twelve months after birth, when the bodies of all the ſix Teeth are pretty well formed; but it never after increaſes in length between the ſymphyſis and the ſixth Tooth; and from this time too, the Alveolar Proceſs, which makes the anterior part of the arches of both Jaws, never becomes a ſection of a larger circle, whence the lower part of a child's face is flatter, or not ſo projecting forwards as in the adult†.

After this time the Jaws lengthen only at their poſterior ends; ſo that the ſixth Tooth, which was under the Coronoid Proceſs in the Lower-Jaw, and in the tubercles of the Upper-Jaw of the Fœtus, is at laſt, *viz.* in the eighth or ninth year, placed before theſe parts; and then the ſeventh Tooth appears in the place which the ſixth occupied, with reſpect to the Coronoid Proceſs, and tubercle; and about the twelfth or fourteenth year, the eighth Tooth is ſituated where the ſeventh was placed.

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* Vide Plate VIII. Fig. 3, 4, 5, 6, for the general increaſe of the Jaws, but more particularly backwards.

† Vide Plate VIII. Fig. 7, for theſe facts.

At the age of eighteen, or twenty, the eighth Tooth is found before the Coronoid Proceſs in the Lower-Jaw, and under, or ſomewhat before the tubercle in the Upper-Jaw, which tubercle is no more than a ſucceſſion of ſockets for the Teeth till they are completely formed.

In a young child the cavity in the temporal bone for the articulation of the Jaw is nearly in a line with the Gums of the Upper-Jaw; and for this reaſon the Condyle of the Lower-Jaw is nearly in the ſame line *; but afterwards, by the addition of the Alveolar Proceſs and Teeth, the line of the Gums in the Upper-Jaw deſcends conſiderably below the articular cavity; and for that reaſon the Condyloid Proceſs is then lengthened in the ſame proportion.

In old people who have loſt all their Teeth, the articulation comes again into the ſame line with the Gums of the Upper-Jaw †; but in the Lower-Jaw, the Condyles cannot be diminiſhed again for accommodating it to the Upper, ſo that it neceſſarily projects beyond the Gums of the Upper-Jaw at the fore part. When the mouth is ſhut, the projection of the Jaw at the chin, fits the two Jaws to each other at that place

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* Vide Plate VIII. Fig. 11.

† Vide Plate VII.

where the Grinders were ſituated, and where the ſtrength of maſtication lies; for if the chin was not further from the center of motion than the Gums of the Upper-Jaw, at the fore part, the Jaws, in ſuch people as have loſt all their Teeth, would meet in a point at the fore part, like a pair of pinchers, and be at a conſiderable diſtance behind *.

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* Vide Plate VII.

THE

REASON for the SHEDDING of the TEETH.

AS the ſhedding of the Teeth is a very ſingular proceſs in the animal œconomy, many reaſons have been aſſigned for it; but theſe reaſons have not carried along with them that conviction which is deſired. Authors have not fully conſidered the appearances which naturally explain themſelves; nor have they conſidered the advantages neceſſarily ariſing from the ſize and conſtruction of only ſuch a number as the firſt ſet; nor have they conſidered fully the diſadvantages that ſuch ſize and conſtruction would have, if continued when it is neceſſary to have a greater number, which is the caſe with the adult.

We ſhall conſider theſe advantages in a child where the ſhedding Teeth are all completely formed, which will be ſetting them in the cleareſt point of light; and alſo, the diſadvantages that would occur, if in the adult theſe were not changed for another ſet ſomewhat different.

If the child had been ſo contrived, as not to have required Teeth till the time of the ſecond ſet's appearing, there would have been no occaſion for a new ſet: but the Jaw-bones being conſiderably ſmaller in children than in adults, and it being neceſſary that they ſhould have two Grinders, there is not room for *Inciſores* and *Cuſpidati* of ſufficient ſize to ſerve through life; and the firſt formed Grinders having neceſſarily too ſmall fangs, and the Jaw increaſing at the back part only, theſe two Grinders would have been protruded too far forwards, and at too great a diſtance from the center of motion. This variation in the ſize of the Teeth is likewiſe a reaſon why the ſecond ſet are not formed in the ſockets of the firſt; and why the old ſockets are deſtroyed.

Theſe circumſtances with regard to the ſhedding of the Teeth, contradict the notion of the ſecond ſet being made broader and thicker, by the reſiſtance they meet with in puſhing out the firſt. For were we on a partial view of the ſubject, to admit the ſuppoſition, the *Bicuſpides* would effectually overturn our hypotheſis; becauſe here the ſecond ſet are much ſmaller than the firſt, and yet the reſiſtance would be greater to them than to the *Inciſores*.

From the manner in which the Teeth are ſhed, it is evident that drawing a temporary Tooth, for the eaſier protruſion of the one underneath, will be of no great ſervice; for in general it falls out before the other can touch it. But it is often of much more ſervice to pull out the neighbouring, or adjacent temporary Tooth; for we muſt be convinced by what has been advanced with regard to the changes in ſize, that excepting the whole were to ſhed at the ſame time, or the order of ſhedding, viz. from before backwards, were to be inverted, that the ſecond ſet of *Inciſores* and *Cuſpidati* muſt be pinched in room, till the Grinders are alſo ſhed: and therefore we find it often of uſe to draw a temporary Tooth, that is placed further back; and it would, perhaps, be right upon the whole, always to draw, at leaſt the firſt Grinder; and, perhaps, ſome time after, the ſecond Grinder alſo.

OF THE

CAVITY filling up as the TEETH wear down.

A TOOTH very often wears down ſo low, that its cavity would be expoſed, if no other alteration were produced in it. To prevent this, nature has taken care that the bottom part of the cavity ſhould be filled up by new matter, in proportion as the ſurface of the Teeth is worn down. This new matter may be eaſily known from the old; for when a Tooth has been worn down almoſt to the neck, a ſpot may always be ſeen in the middle, which is more tranſparent, and at the ſame time of a darker colour, (occaſioned, in ſome meaſure, by the dark cavity under it) and is generally ſofter than the other *. Any perſon may be convinced of the truth of theſe obſervations, by taking two Teeth of the ſame claſs, but of very different ages, one juſt completely formed, the other worn down almoſt to its neck. In the laſt he will obſerve the dark ſpot in the center; and if as much is cut off from the complete

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* Vide Plate XIV. Fig. 24, 25.

Tooth as hath been worn off the old one, the cavity of the young Tooth will be found cut through; and on examining the other, its cavity will be found filled up below that ſurface. Now this obſervation contradicts the idea of the hole leading into the cavity of the Tooth being cloſed up; and what is ſtill a further proof of it, I have been able to inject veſſels in the cavities of the Teeth in very old people when the Alveolar Proceſs has been gone, and the Teeth very looſe in the Gum.

Old people are often found to have very good ſets of Teeth, only pretty much worn down. The reaſon of this is, that ſuch people never had any diſorder in their Teeth, or Alveolar Proceſſes, ſufficient to occaſion the falling of one Tooth. For if by accident one Tooth is loſt, the reſt will neceſſarily fail in ſome degree, even though they are ſound, and likely to remain ſo, had not this accident happened; and this weakening cauſe is greater, in proportion to the number that are loſt. From this obſervation, we ſee that the Teeth ſupport one another.

OF THE

CONTINUAL GROWTH of the TEETH.

IT has been aſſerted that the Teeth are continually growing, and that the abraſion is ſufficient to keep them always of the ſame length; but we find that they grow at once to their full length, and that they gradually wear down afterwards; and that there is not even the appearance of their continuing to grow. The Teeth would probably project a little farther out of the Gum, if they were not oppoſed by thoſe in the oppoſite Jaw; for in young people, who had loſt a Tooth before the reſt had come to their full length, I have ſeen the oppoſite Tooth project a little beyond the reſt, before they were not at all worn down. hardly It may be further obſerved, that when a Tooth is loſt, the oppoſite one may project from the diſpoſition of the Alveolar Proceſs to riſe higher, and fill up at the bottom of the ſockets; and the want of that natural preſſure ſeems to give that diſpoſition to theſe proceſſes, which is beſt illuſtrated in thoſe Teeth which are formed deeper in their ſockets than uſual. As a proof that the Teeth continue growing, it has been ſaid that the ſpace of a fallen Tooth is almoſt filled up by the increaſed thickneſs of the two adjacent Teeth, and the lengthening of that which is oppoſite. There is an evident fallacy in the caſe; either the obſervations have been made upon ſuch Jaws as above deſcribed, or the appearances have not been examined with ſufficient accuracy; for when the ſpace appears to have become narrow by the approximation of the two adjacent Teeth, it is not owing to any increaſe of their breadth, but to their moving from that ſide where they are well ſupported, to the other ſide, where they are not. For this reaſon they get an inclined direction; and I obſerve it extends to the ſeveral adjacent Teeth in a proportional leſs degree, and affects thoſe which are behind *, more than thoſe which are before the vacant ſpace.

In the Lower-Jaw the back Teeth are not fixed perpendicularly, but all inclined forward; and the depreſſion of the Jaw increaſes this poſition: the action of the Teeth, when thrown out of the perpendicular, has alſo a tendency to increaſe that oblique direction, as a pair of ſciſſars, in cutting, puſhes every thing forward, or from the center of motion: therefore this alteration, I think, is moſt commonly obſervable in the Lower-Jaw.

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* Vide Plate XVI. Fig. 1, *b*, *c*.

And that Teeth are not actually always growing in breadth, muſt be obvious to every perſon who conſiders, that in many people, through life, the Teeth ſtand ſo wide from each other, that there are conſiderable ſpaces between them; which could not be the caſe if they were always growing in thickneſs.

We might add too, that according to the hypotheſis, the *Dens Sapientiæ* ſhould grow to an enormous ſize backward, becauſe there it has no check from preſſure; and in people where the *Dens Sapientiæ* is wanting in one Jaw, which is very common, it ſhould grow to an uncommon length in the oppoſite Jaw, for the ſame reaſon. But neither of theſe things happens.

I need hardly take notice, that when a Tooth has loſt its oppoſite, it will in time become really ſo much longer than the reſt, as the others grow ſhorter by abraſion; and I obſerve that the Tooth which is oppoſite to the empty ſpace, becomes in time not only longer for the above-mentioned reaſon, but more pointed. The apex falls into the void ſpace, and the two ſides are rubbed away againſt the ſides of the two approaching Teeth next to that ſpace.

The manner of their formation likewiſe ſhews that Teeth cannot grow beyond a certain limited ſize. To illuſtrate this I may obſerve, that I have often, in the dead body of adults, found the left *Cuſpidatus* of the Upper-Jaw, with its points ſcarcely protruding out of the Alveolar Proceſs, though the Tooth was completely formed, and longer than the other by the whole point, which in that other was worn away *. This Tooth, at its firſt formation, had been deeper in the Jaw than what is common; and after it had grown to the ordinary ſize, it grew no longer, though it had not the reſiſtance of the oppoſite Teeth to ſet bounds to its increaſe: yet commonly in theſe caſes the Tooth continues to project further and further through the Gum; though this is not owing to its growing longer, but to the ſocket filling up behind it, and thereby continuing to puſh it out by ſlow degrees.

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* Vide Plate VIII. Fig. 8.

OF THE

SENSIBILITY of TEETH.

THE Teeth would ſeem to be very ſenſible; for they appear to be ſubject to great pain, and are eaſily and quickly affected by either heat or cold.

We may preſume that the bony ſubſtance itſelf, is not capable of conveying ſenſations to the mind, becauſe it is worn down in maſtication, and occaſionally worked upon by operators in living bodies, without giving any ſenſation of pain in the part itſelf.

In the cavity of a Tooth it is well known that there is exquiſite ſenſibility; and it is likewiſe believed, that this is owing to the nerve in that cavity. This nerve would ſeem to be more ſenſible than nerves are in common; as we do not obſerve the ſame violent effects from any other nerve in the body being expoſed either by wound, or ſore, as we do from the expoſure of the nerve of a Tooth. Perhaps the reaſon of the intenſeneſs, as well as the quickneſs of the ſenſe of heat and cold in the Teeth, may be owing to their communicating theſe to the nerve ſooner than any other part of the body.

OF

OF

SUPERNUMERARY TEETH.

WE often meet with Supernumerary Teeth; and this, as well as ſome other variations, happens oftener in the Upper than in the Lower-Jaw, and, I believe, always in the *Inciſores* and *Cuſpidati*. I have only met with one inſtance of this ſort, and it was in the Upper-Jaw of a child about nine months old: there were the bodies of two Teeth, in ſhape like the *Cuſpidati*, placed directly behind the bodies of the two firſt permanent *Inciſores*; ſo that there were three Teeth in a row, placed behind one another, viz. the temporary *Inciſor*, the body of the permanent *Inciſor*, and that ſupernumerary Tooth. The moſt remarkable circumſtance was, that theſe Supernumerary Teeth were inverted, their points being turned upwards, and bended by the bone which was above them not giving way to their growth, as the Alveolar Proceſs does.

It often happens that the *Inciſores* and *Cuſpidati*, in the Upper-Jaw eſpecially, are ſo irregularly placed, as to give the appearance of a double row. I once ſaw a remarkable inſtance of this in a boy; the ſecond *In-*

ciſor in each ſide was placed farther back than what is common, and the *Cuſpidatus* and firſt *Inciſor* cloſer together, than if the ſecond *Inciſor* had been directly between them; ſo that the appearance gave an idea of a ſecond row of Teeth.

This happens only in the adult ſet of Teeth, and is owing to there not being room in the Jaw for this ſecond ſet, the Jaw-Bone being formed with the firſt ſet of Teeth, and never increaſing afterwards; ſo that if the adult ſet does not paſs further back, they muſt over-lap each other, and give the appearance of a ſecond row.

OF THE

USE of the TEETH ſo far as they affect the VOICE.

THE Teeth ſerve principally for maſtication; and that uſe need not be farther explained.

They ſerve likewiſe a ſecondary, or ſubordinate purpoſe; giving ſtrength and clearneſs to the ſound of the voice, as is evident from the alteration produced in ſpeaking, when the Teeth are loſt.

This alteration, however, may not depend entirely upon the Teeth, but, in ſome meaſure, on the other organs of the voice having been accuſtomed to them; and therefore when they are gone, thoſe other organs may be put out of their common play, and may not be able to adapt themſelves ſo well to this new inſtrument. Yet I believe that habit in this caſe has no great effect; for thoſe people ſeldom or never do get the better of the defect; and young children, who are ſhedding their Teeth, and are, perhaps, without any Fore Teeth for half a year or more, always have that defect in their voice, till the new Teeth come; and as theſe grow the voice becomes clear again.

This uſe ſeems to be entirely in the Fore Teeth; for the loſs of one of theſe makes a great alteration, and the loſs of two or three Grinders ſeems to have no ſenſible effect. As an argument for the uſe of the Teeth in modifying the ſound of the voice, we may obſerve, that the Fore Teeth come at a time when the child begins to articulate ſounds, and at that time they are ſo looſe in the gums, that they can be of very little ſervice in maſtication.

Every defect in ſpeech, ariſing from this defect in the organ, is generally attended with what we call a liſp. People who have loſt all their Teeth, and moſt old people for that reaſon, loſe, in a great meaſure, their voice. This ariſes partly from the loſs of the Fore Teeth, but principally from the loſs of all the Teeth, and of the Alveolar Proceſſes of both Jaws, by which means the mouth becomes too ſmall for the tongue, and the lips and cheeks become flaccid; inſomuch that the nicer movements of theſe parts, in the articulation of ſounds, are obſtructed; and thence the words and ſyllables are indiſtinctly pronounced, and ſlurred, or run into one another.

Under

Under what CLASS do the HUMAN TEETH come.

NATURAL Hiſtorians have been at great pains to prove from the Teeth, that man is not a carnivorous animal; but in this, as in many other things, they have not been accurate in their definitions; nor have they determined what a carnivorous animal is.

If they mean an animal that catches and kills his prey with his Teeth, and eats that fleſh of the prey juſt as it is killed, they are in the right; man is not in this ſenſe a carnivorous animal, and therefore he has not Teeth like thoſe of a Lion; and this, I preſume, is what they mean.

But if their meaning were that the Human Teeth are not fitted for eating meat that has been catched, killed, and dreſſed by art, in all the various ways that the ſuperiority of the human mind can invent, they are in the wrong. Indeed, from this confined way of thinking it would be hard to ſay what the human Teeth are fitted for; becauſe, by the ſame reaſoning man is not a graminivorous animal, as his Teeth are not fitted for pulling vegetable food, &c. They are not made like thoſe of cows or horſes, for example.

The light in which we ought to view this ſubject is, that man is a more perfect or complicated animal than any other; and is not made like others, to come at his food by his Teeth, but by his hands, directed by his ſuperior ingenuity; the Teeth being given only for the purpoſe of chewing the food, in order to its more eaſy digeſtion: and they, as well as his other organs of digeſtion, are fitted for the converſion of both animal and vegetable ſubſtances into blood; and thence he is able to live in a much greater variety of circumſtances than any other animal, and has more opportunities of exerciſing the faculties of his mind. He ought, therefore, to be conſidered as a compound, fitted equally to live upon fleſh and upon vegetables.

OF THE

DISEASES of the TEETH.

THE Teeth are ſubject to diſeaſes as well as other parts of the body. Whatever the diſorder is that affects them, it is generally attended with pain; and from this indeed we commonly firſt know that they are affected.

Pain in the Teeth proceeds, I believe, in a great meaſure, from the air coming into contact with the nerve in the cavity of the Tooth; for we ſeldom ſee people affected with the Tooth-ach, but when the cavity is expoſed to the air.

It is not eaſy to ſay by what means the cavity comes to be expoſed.

The moſt common diſeaſe to which the Teeth are ſubject, begins with a ſmall, dark coloured ſpeck, generally on the ſide of the Tooth where it is not expoſed to preſſure; from what cauſe this ariſes is hitherto unknown. The ſubſtance of the Tooth thus diſcoloured, gradually decays, and an opening is made into the cavity. As ſoon as the air is thereby admitted, a conſiderable degree of pain ariſes, which is probably owing to the admiſſion of the air, as it may be prevented by filling the cavity with lead, wax, &c. This pain is not always preſent; the food, and other ſubſtances, perhaps fill up the hole occaſionally, and prevent the acceſs of the air, and of conſequence the pain, during the time they remain in it. When an opening is made into the cavity of the Tooth, the inſide begins to decay, the cavity becomes larger, the breath at the ſame time often acquires a putrid *Fœtor*, the bone continues to decay till it is no longer able to ſupport the preſſure of the oppoſite Tooth, it breaks and lays the cavity open. We have not as yet found any means of preventing this diſeaſe, or of curing it; all that can be done, is to fill the hole with lead, which prevents the pain, and retards the decay; but after the Tooth is broken, this is not practicable; and for that reaſon it is then beſt to extract it.

It would be beſt of all to attempt the extraction of a Tooth by drawing it in the direction of its axis: but that not being practicable by the inſtruments at preſent in uſe, which pull laterally, it is the next beſt to draw a Tooth to that ſide where the Alveolar Proceſs is weakeſt; which is the inſide, in the two laſt grinders on each ſide of the Lower-Jaw, and the outſide in all the others.

It generally happens in drawing a Tooth, that the Alveolar Proceſs is broken, particularly when the Grinders are extracted; but this is attended with no bad conſequences, as that part of the Alveolar Proceſs from which the Tooth was extracted always decays.

In drawing a Tooth, the patient complains of a diſagreeable jarring noiſe, which always happens when any thing grates againſt the bones of the head.

OF

CLEANING the TEETH.

FROM what was ſaid of the nature and uſe of the Enamel, it is evident, that whatever is capable of deſtroying it, muſt be hurtful; therefore all acids, gritty powders, and injudicious methods of ſcaling the Teeth are prejudicial: but ſimply ſcaling the Teeth, that is, clearing them of the ſtony concretions which frequently collect about their necks, while nothing is ſcraped off but that adventitious ſubſtance, is proper and uſeful. If not removed by art, the quantity of the ſtony matter is apt to increaſe, and to affect the gum. This matter firſt begins to form on the Tooth near to the Gum; but not in the very angle, becauſe the motion of the Gum commonly prevents the accumulation of it at this part. I have ſeen it cover not only the whole Tooth, but a great part of the Gum: in this caſe there is always an accumulation of a very putrid matter, frequently conſiderable tenderneſs and ulceration of the Gum, and ſcaling becomes abſolutely neceſſary *.

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* The animal fluids, when out of the courſe of the general circulation, eſpecially when they ſtagnate in cavities, are apt to depoſit an abſorbent earth, and form concretions. This earth is ſometimes contained in the fluids; and is only depoſited; as in the formation of the ſtone in the urinary paſſages: in ſome caſes, perhaps, the fluids undergo a change, by which the earth is firſt formed, and afterwards depoſited. This depoſition takes place particularly in weakened parts, or where the circulation is languid, or where there are few arteries, ſuch as about joints and tendons; as if it were intended to ſtrengthen theſe parts, if they ſhould at any time give way; for if an artery, for inſtance, is overcome by the action of the heart, and unnaturally dilated, its coats have commonly theſe concretions formed every where in their interſtices. The ſame thing happens alſo in the coats of incyſted tumors, which are conſtantly diſtended; in caſes of diſtentions of the Tunica Vaginalis Teſtis, &c. It is alſo apt to take place in parts which have loſt their natural functions; as in the coats of the eye in caſes of blindneſs, and in diſeaſed lymphatic glands, &c. and where the living power is diminiſhed in the ſyſtem, as in the arteries, membranes, &c. of old people; and in ſome particular habits, as in thoſe who are affected by the gout.

The ſame ſort of depoſition takes place likewiſe where there is any ſubſtance with ſuch properties as render it a fit *Baſis* for cryſtallization; as when extraneous bodies are lodged in the bladder: whence ſuch bodies are ſo often found to form the *Nucleus* of a ſtone. The ſame thing happens in the bowels of many animals; whence the *Nucleus* of inteſtinal concretions, or bezoars, is commonly a nail, or ſome indigeſtible ſubſtance which had been ſwallowed. The cruſt, which collects upon the Teeth, ſeems to be a cryſtallization of the ſame nature.

OF

TRANSPLANTING the TEETH.

FROM conſidering the almoſt conſtant variety of the ſize and ſhape of the ſame claſs of Teeth in different people, it would appear almoſt impoſſible to find the Tooth of one perſon that ſhould fit, with any degree of exactneſs, the ſocket of another; and this obſervation is ſupported, and indeed would ſeem to be proved by obſerving the Teeth in ſkeletons. Yet we can actually tranſplant a Tooth from one perſon to another, without great difficulty, nature aſſiſting the operation, if it is done in ſuch a way that ſhe can aſſiſt; and the only way in which nature can aſſiſt, with reſpect either to ſize or ſhape, is by having the fang of the tranſplanted Tooth rather ſmaller than the ſocket. The ſocket, in this caſe grows to the Tooth. If the fang is too large, it is impoſſible indeed to inſert it at all in that ſtate; however, if the fang ſhould be originally too large, it may be made leſs; and this ſeems to anſwer the purpoſe as well.

The ſucceſs of this operation is founded on a diſpoſition in all living ſubſtances, to unite when brought into contact with one another; although they are of a different ſtructure; and even although the circulation is only carried on in one of them.

This diſpoſition is not ſo conſiderable in the more perfect or complex animals, ſuch as quadrupeds, as it is in the more ſimple or imperfect; nor in old animals, as in young: for the living principle in young animals, and thoſe of ſimple conſtruction, is not ſo much confined to, or derived from one part of the body; ſo that it continues longer in a part ſeparated from their bodies, and even would appear to be generated in it for ſome time; while a part, ſeparated from an older, or more perfect animal, dies ſooner, and would appear to have its life entirely dependent on the body from which it was taken.

Taking off the young ſpur of a cock, and fixing it to his comb, is an old and well known experiment.

I have alſo frequently taken out the *Teſtis* of a cock and replaced it in his belly, where it has adhered, and has been nouriſhed; nay, I have put the *Teſtis* of a cock into the belly of a hen with the ſame effect.

In like manner a freſh Tooth, when tranſplanted from one ſocket to another, becomes to all appearance a part of that body to which it is now attached, as much as it was of the one from which it was taken; while a Tooth which has been extracted for ſome time, ſo as to loſe the whole of its life, will never become firm or fixed; the ſockets will alſo in this caſe acquire the diſpoſition to fill up, which they do not in the caſe of the inſertion of a freſh Tooth.

Theſe appearances ſhew that the living principle exiſts in the ſeveral parts of the body, independent of the influence of the brain, or circulation, and that it ſubſiſts by theſe, or is indebted to them for its continuance; and in proportion as animals have leſs of brain and circulation, the living power has leſs dependence on them, and becomes a more active principle in itſelf; and in many animals there is no brain nor circulation, ſo that this power is capable of being continued equally by all the parts themſelves, ſuch animals being nearly ſimilar in this reſpect to vegetables.